CROPS & SOILS RESEARCH 1971

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INTRODUCTION

Research Program in the Department of Agronomy

This report gives the research in progress in the Department of Agronomy. The research program in the Department includes the development of improved crop varieties and improved soil and crop management practices that result in more efficient production. Considerable emphasis is also given to research on soil and water conservation, soil and water use, soil-water pollution, air pollution and the disposal of waste materials.

The wide range of soils and 1.9 million acres of agronomic crops (corn, soybeans, tobacco, small grain, turfgrasses, hay, and pasture) grown in the state with a value of approximately 175 million dollars emphasize the size and importance of the research program in agronomy. To solve crops and soils problems research work is conducted at University Laboratories, on the outlying Experiment Station Farms, and cooperatively with farmers, golf course superintendents, and others throughout the state. The help and cooperation received from the many people in the state in carrying out our research program is greatly appreciated.

James R. Miller

Chairman, Department of Agronomy

R. L. Green

Acting Director, Maryland Agric. Expt. Sta.

Agricultural Waste Water Accommodation and Utilization by Various Forages

G. L. Miller and J. H. Axley
Department of Agronomy

Purpose and Objectives

The Eastern Shore of Maryland has a number of poultry processing plants which process thousands of chickens each day. These plants in order to compete on the world market must have a low operational cost and a low cost waste disposal system is very important for such a program. Many of the plants dispose their wastes by irrigating the effluent on the land and thereby utilizing the soil as a renovating and filtering system. Whereas this system is economical and efficient it sometimes fails due to mismanagement. This research work was initiated to study the sprinkler irrigation system for the disposal of waste.

The objectives were:

1. To determine the effects of the waste waters from a poultry processing plant on the growth of forages.

2. To determine the influence of the rate of application of these waste waters on their rate of infiltration in the soil and finally the quality of the water after rectification.

Procedure

Sassafras sandy loam in columns, 17" long $2\frac{1}{2}$" in diameter, were used to simulate field soil conditions in the laboratory. Also, longer columns, 5' long and 3" in diameter were used. They were treated as follows; 1) continuous effluent application, 2) continuous distilled water, 3) 4.0 inches distilled H_2O per day, and 4) a continuous application of a clear sugar solution containing the same carbon level as the

waste water of the plant.

Results

Excessive irrigation with these waste waters and sugar solution resulted in reddish-brown drainage waters which produced an odor similar to hydrogen sulfide that was most disagreeable. This did not occur when proper levels of irrigation effluent were applied.

The infiltration rates, of excessively-irrigated waste water, reduced with time; this was accompanied by an increase in pH and electrical conductivity of the drainage waters and an increase in odor (Figures 1 and 2 and Table 1). Irrigation rates of 4.0 inches distilled water per day under laboratory conditions did not lower infiltration rates nor reduce the high quality of the drainage waters.

The reddish-brown portion of the drainage waters were investigated. The material appeared to be cells of organisms which showed the presence of ferrous and ferric iron when tested chemically. The fresh drainage samples showed the presence of ferrous iron and older samples exposed to oxygen showed the presence of ferric iron. These observations are similar to those made in many drinking water reservoirs and have been attributed to iron reducing bacteria and sulfur reducing bacteria.

Summary

1. Excessive poultry processing plant waste water applications to the soil greatly reduced infiltration rates. This seems to be a result of microbial growth which occurs under anaerobic conditions.

2. With aerobic surface conditions, good infiltration rates were maintained.

3. Anaerobic surface conditions may result in reddish-brown material in drainage waters, possibly from the growth of iron bacteria.

Table 1. Odor ratings for thirteen columns.

Column No.	Treatment	Odor Rating[1]		
		3/8/72	3/16/72	3/22/72
1	4 inches distilled water/day	0.2*	0.0	0.3
2	4 inches distilled water/day	0.0	0.1	0.0
8	4 inches distilled water/day	0.0	0.1	0.0
3	continuous clear sugar solution	2.0	1.4	1.8
4	continuous clear sugar solution	1.8	1.7	1.7
5	continuous clear sugar solution	1.8	1.9	1.7
6	continuous distilled water	0.0	0.1	0.0
7	continuous distilled water	0.0	0.0	0.0
12	continuous distilled water	0.1	0.0	0.1
13	continuous distilled water	0.2	0.1	0.1
9	continuous effluent	1.3	0.6	0.7
10	continuous effluent	0.2	0.0	0.0
11	continuous effluent	0.8	0.5	0.7

1 Odor rating: 0 = no odor, 2 = raunchy odor

* 8 replications/odor rating

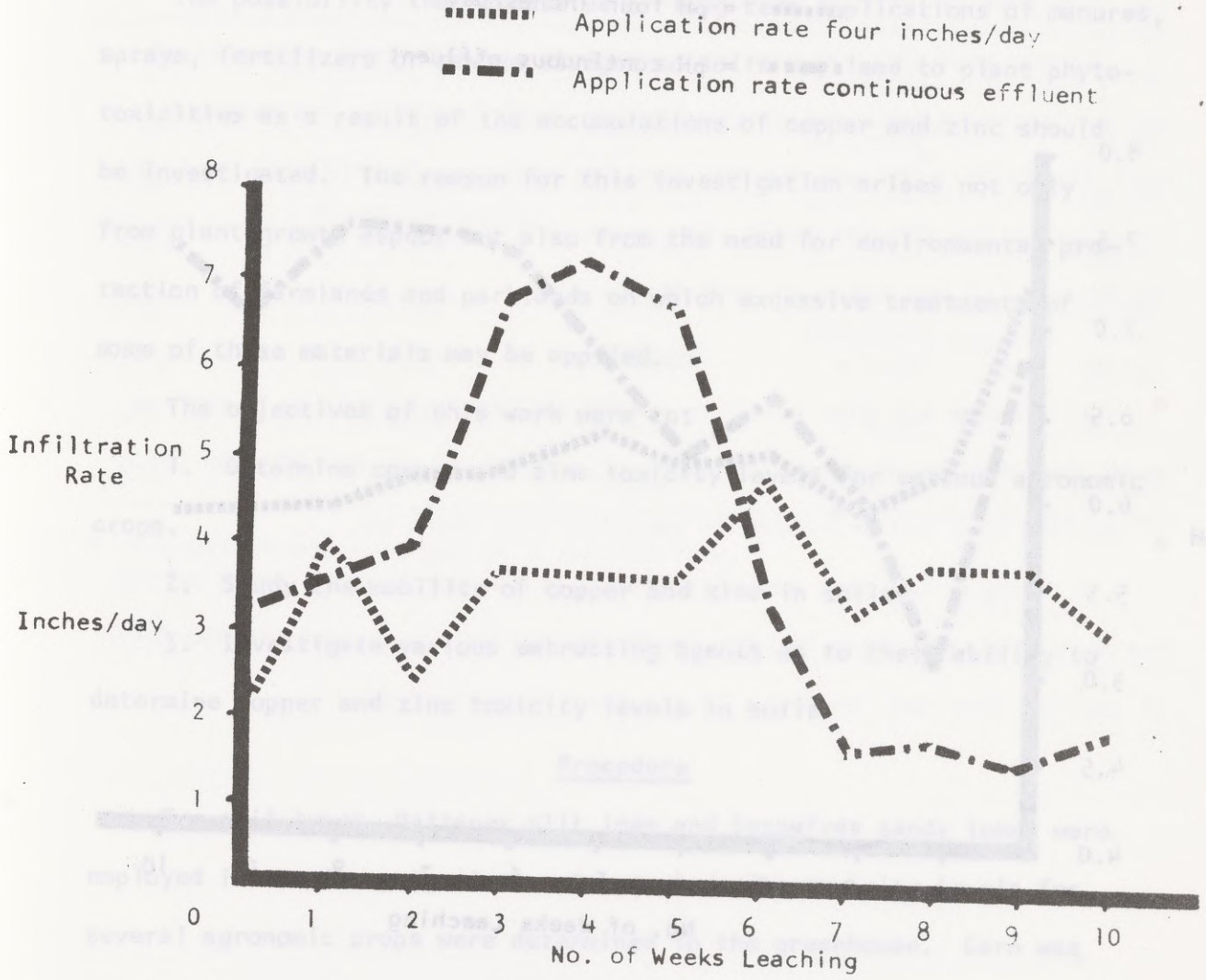

Application rate four inches/day
Application rate continuous effluent
Infiltration Rate
Inches/day
8
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
8
9
10
No. of Weeks Leaching

FIGURE 1

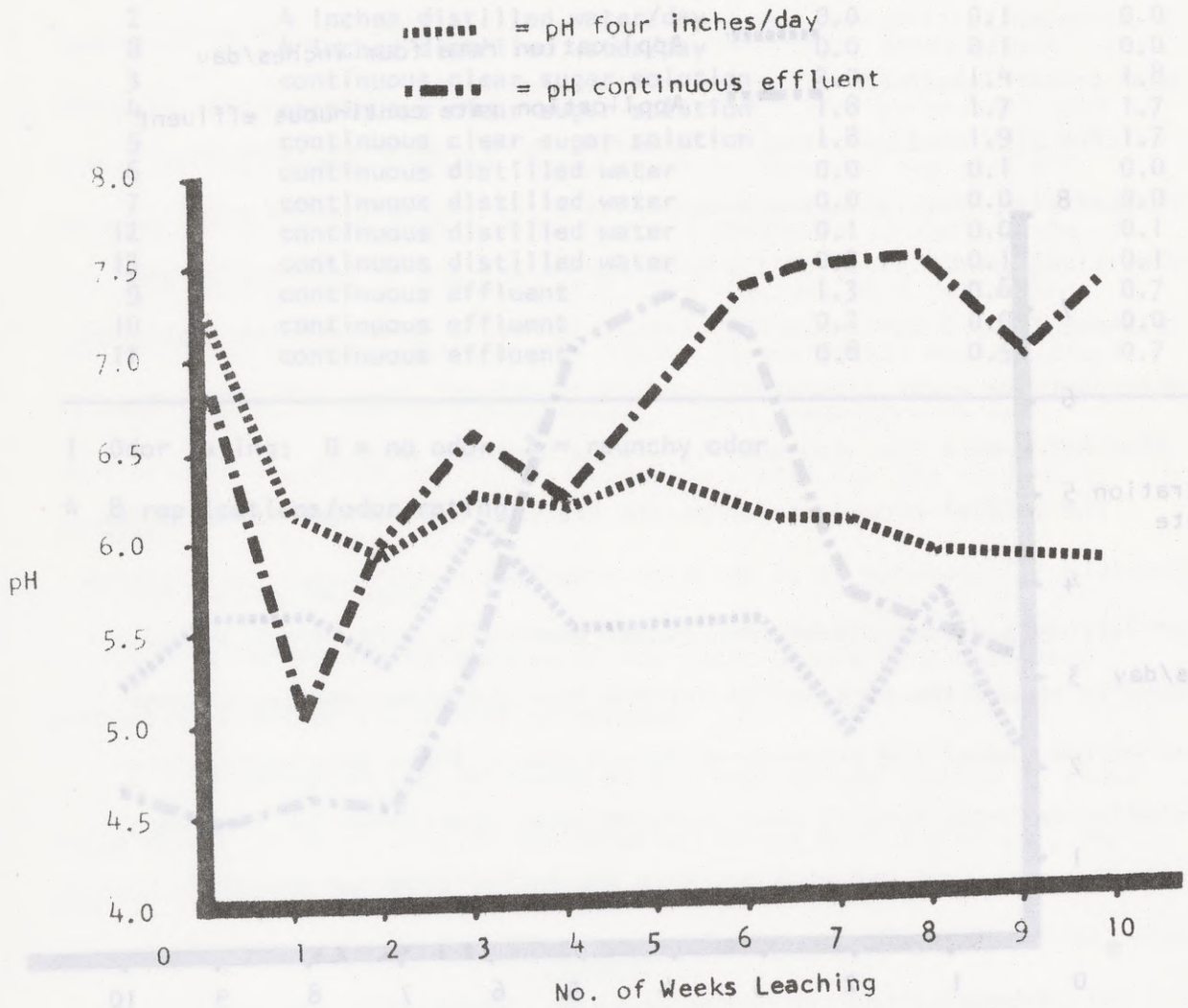


FIGURE 2

The pH change of ground water from Sassafras sandy loam when submerged in effluent or treated with four inches of distilled water per day.

Soil Testing for Copper and Zinc to be Used in The Environmental Control of Phytotoxicities

J. H. Axley and R. F. Korcak
Department of Agronomy

Purpose and Objectives

The possibility that excessive or long term applications of manures, sprays, fertilizers or sewage sludges to soils may lead to plant phytotoxicities as a result of the accumulations of copper and zinc should be investigated. The reason for this investigation arises not only from plant growth aspect but also from the need for environmental protection of farmlands and parklands on which excessive treatments of some of these materials may be applied.

The objectives of this work were to:

1. Determine copper and zinc toxicity levels for various agronomic crops.
2. Study the mobility of copper and zinc in soils.
3. Investigate various extracting agents as to their ability to determine copper and zinc toxicity levels in soils.

Procedure

Two soil types, Mattapex silt loam and Sassafras sandy loam, were employed in the investigations. Copper and zinc toxicity levels for several agronomic crops were determined in the greenhouse. Corn was grown on both soil types and initial pH's were 6.0 and 6.2 for the Mattapex and Sassafras soils, respectively. Copper additions ranged from 0-525 lbs/A supplied as $CuSO_4 \cdot 5H_2O$. Zinc additions ranged from 0-3200 lbs/A, supplied as $ZnSO_4 \cdot 7H_2O$. Plants were grown in the greenhouse for 17 days in the copper experiment and for 35 days in the zinc experiment. Soil samples were taken from all of the soils receiving the different copper

and zinc treatments. Copper and zinc were determined on each of the soil samples vis 3 extraction procedures, 0.1N HCl; EDTA-$(NH_4)_2CO_3$; and 0.05N HCl plus 0.025N H_2SO_4. Plants were harvested, oven dried and analyzed for copper and zinc.

Results

The results to date pertain only to objectives 1 and 3.

Copper toxicity symptoms were noted at the 225 lbs/A copper level on the Sassafras soil and at the 300-375 lbs/A levels on the Mattapex soil (Table 1). The results for zinc toxicity on corn indicate toxicity symptoms at the 200-400 lbs/A zinc range on the Sassafras soil and 400-800 lbs/A range on the Mattapex soil (Table 2).

Summary

1. Copper and zinc toxicity levels in the corn plant on Sassafras sandy loam begins at about 225 lbs/A of applied copper and 200-400 lbs/A of applied zinc and increased in severity from there on.

2. Copper and zinc toxicity levels in the corn plants grown on the Mattapex silt loam were 300-375 lbs/A of applied copper and 400-800 lbs/A of applied zinc and increased in severity from there on.

Table 1. Effect of Cu on Yield of Corn on Sassafras Sl, and Mattapex Sil

Cu level lbs/A	Sassafras*		Mattapex**	
	Dry wt-g	ppm Cu in soil	Dry wt-g	ppm Cu in soil
0	1.56	0.40	1.14	0.20
75	1.55	23.10	1.28	20.15
150	1.40	41.10	1.10	35.50
	Chlorosis begins			
225	1.33	74.50	0.97	69.75
300	1.03	91.85	1.05	85.40
			Chlorosis begins	
375	0.85	123.30	0.90	96.30
450	0.76	143.00	0.91	131.20
525	0.64	160.00	0.95	126.00

* All values are averages of 4 replications.

Table 2. Effect of Zn on Yield of Corn on Sassafras Sl and Mattapex Sil

Zn level lbs/A	Sassafras*		Mattapex*	
	Dry wt-g	ppm Zn in soil	Dry wt-g	ppm Zn in soil
0	28.10	1.87	22.56	2.73
100	26.83	39.07	22.26	39.13
200	22.53	79.60	22.20	97.13
	Chlorosis begins			
400	18.50	135.80	22.43	141.73
			Chlorosis begins	
800	12.80	192.53	20.56	325.40
1600	7.13	370.60	17.83	462.93
3200	2.26	1146.13	7.93	855.73

* All values are averages of 3 replications.

Uptake of Atmospheric Ammonia by Plants

Milton Meyer and J. H. Axley

Department of Agronomy

Purpose and Objectives

Many years ago the first agricultural scientists concerned themselves with aereal born ammonia and nitrate nitrogen. They found that about 6 to 20 lbs/Acre of air-born nitrogen was brought to the earth by rainfall.

Since this finding great advances have been made in the manufacture and use of nitrogen fertilizers but little additional information as to the use by plants of the very dilute supply of ammonia that circulates with the air around the world.

People know the supply is augmented by the ammonia gases from decaying plants and manures, from coal burning equipment, from automobile exhausts, etc. but how the ammonia left the atmosphere and returned to earth other than in rainfall was not known until the last ten years. It has now been shown that soils may absorb about 30 to 50 lbs. of ammonia nitrogen per acre per year. Open waters also seem to remove some of the ammonia from the air and there is some circumstantial evidence to support this philosophy.

With this evidence at hand, University of Maryland agronomists wondered if plants might not be an important agent in the removal of ammonia from the atmosphere. It was for this reason this research was initiated to study the possible uptake of ammonia by plants from the atmosphere at concentrations normally present therein.

Procedure

The heavy isotope of nitrogen ^{15}N was used to tag the more abundant ^{14}N in the ammonia released into the atmosphere of a growth chamber from which all of the naturally occurring ammonia had been removed. Plants were

grown in the chamber in such a manner that the soil and roots were removed from contact with the chamber air but were in contact with normal air. The ammonia placed into the growth chamber atmosphere was at a very low level which approximately duplicated normal ammonia levels in the air.

Results

This appears to be the first study to prove conclusively that plants can remove ammonia from the atmosphere at normally occurring ammonia levels. The level of ammonia in New York City air varies from about 30 to 80 ug/m^3. The concentrations of ^{15}N tagged NH_3 used in this investigation were 22 ug/m^3, 110 ug/m^3, and 320 ug/m^3 (Table 1). All plants in the tests (corn, Virginia pine, pigweed, alfalfa, and soybeans) extracted significant quantities of NH_3-N from the air. The removal of aerial NH_3 by the young Virginia pine was traced to the plant tissue. The highest concentration of ^{15}N occurred in the layers exterior to the woody tissue or cambium. The needles also had a high level of extracted NH_3.

The evolution of NH_3 from plants to the air was also investigated using ^{15}N in the soil in which the plants grew. Much smaller quantities of NH_3 were evolved in an NH_3-free atmosphere, than were removed from the atmosphere when the aerial concentration was 22 ug/m^3.

Very rough calculations suggest that field corn can utilize about 30 lbs N/A as atmospheric NH_3.

Summary

1. Plants utilize portions of the very low levels of ammonia found in the atmosphere.

2. Very rough calculations suggest possible use by field corn to be 30 lbs/A of nitrogen in the form of atmospheric ammonia.

3. These results indicate the sources of plant nitrogen are even more complex than previous findings lead one to believe.

Table 1. Ammonia taken from growth chamber air by plants.

Adjusted ammonia levels in growth chamber air	Amount of ammonia taken up by plants
micrograms/cu meter	%
320	53
110	30
22	29

Breeding for Black Shank and Mosaic Resistance in Maryland Tobacco, 1971

M. K. Aycock, Jr.
Department of Agronomy

Purpose and Objectives

A number of diseases attack tobacco grown in southern Maryland; therefore, a large part of the breeding program at the University of Maryland is concerned with disease resistance. At the present time the tobacco mosaic virus appears to be the most destructive disease and until recently, none of the varieties being grown had mosaic resistance. Other diseases which cause some loss in Maryland tobacco each year are black root rot (Thielaviopsis basicola), wildfire (Pseudomonas tabaci), black shank (Phytophthora parasitica var. nicotianae), and fusarium wilt (Fusarium oxysporum var. nicotianae). At present the tobacco breeding program is concerned with developing varieties with resistance to two diseases — tobacco mosaic and black shank.

Procedures

Breeding for Black Shank Resistance. The source of resistance to black shank presently being used is from Md. 59 and Md. 609 which are two varieties released in 1965. These two varieties were developed by Dr. O. D. Morgan, and the source of black shank resistance was from Florida 301.

During January and February, 1971 a modification of a black shank screening procedure utilized at the University of Kentucky was used to screen 100 entries in the F_2 to F_8 generations. The procedure involved planting approximately 10 to 15 seeds of an entry in a vermiculite-filled 50 ml polypropylene centrifuge tube. About 4 weeks after seeding the seedlings were inoculated with the black shank fungus. Two weeks after inoculation the entries were

scored on above ground plant parts (leaves and stems) and the roots. A scoring system of 0, 1, 2, 3 and 4 was utilized for the leaves and stems with a score of 0 representing no symptoms of the disease and a score of 4 representing complete death of all seedlings. A similar system was used for the roots symptoms with 0 representing no symptoms (roots white) and 4 representing severe browning of the entire root system.

Breeding for Mosaic Resistance. During the summer of 1970, 89 entries in the F_2 to the F_8 generations were screened for mosaic resistance. Each entry was represented by 28 plants. Just prior to flowering, plants were inoculated with the tobacco mosaic virus by rubbing the leaf with cheesecloth saturated in a solution of the virus. Approximately one week after inoculation, readings were made on the number of resistant and susceptible plants in each entry. At the time of scoring the resistant plants exhibited small necrotic spots at the site of inoculation while the susceptible plants exhibited the characteristic mosaic pattern of dark and light green areas in the new growth. The necrotic spots of the resistant plants are due to a hypersensitive reaction of the leaf tissue to the virus. When the virus contacts the leaf cells, the cells die at such a rapid rate that the virus cannot spread.

Results

Black Shank Resistance. The results of the screening procedure for black shank resistance are presented in Figure 1. Considerable variation was found among the entries for black shank resistance. A few entries appeared to have complete resistance while others were completely susceptible. From the leaf and stem scores, 21.0% of the entries received a score of 1.5 or better while 6.0% of the root scores fell within this same range. Entries with a score of 1.5 would probably have adequate resistance under field conditions in southern Maryland.

One reason for the wide variation among the entries for black shank resistance could be due to the nature of inheritance of the resistance. Resistance is believed to be dependent upon two major genes and several modifiers; therefore, through breeding the ultimate objective is to capture the two major genes and accumulate as many of the modifiers as possible.

Mosaic Resistance. The results of the tobacco mosaic screening procedure are shown in Figure 2. Resistance is determined by a single dominant gene; therefore, the plants fell into one of two classes — resistant or susceptible. Approximately 90.0% of the entries were resistant. For the resistant entries, 21.0% appeared to be homozygous or true breeding and 69.0% were heterozygous or still segregating at the mosaic resistant locus.

Summary

Breeding lines with resistance to black shank and tobacco mosaic are being developed. Screening techniques which are relatively simple and reliable are being used in the greenhouse and summer breeding nursery. Lines with good resistance based on greenhouse and field results were advanced an additional generation in the field nursery during the summer. Selection for plant type and other desirable agronomic traits was done in the field nursery.

Some of the breeding lines which have good resistance and desirable plant types have been observed in preliminary field trials under replicated conditions.

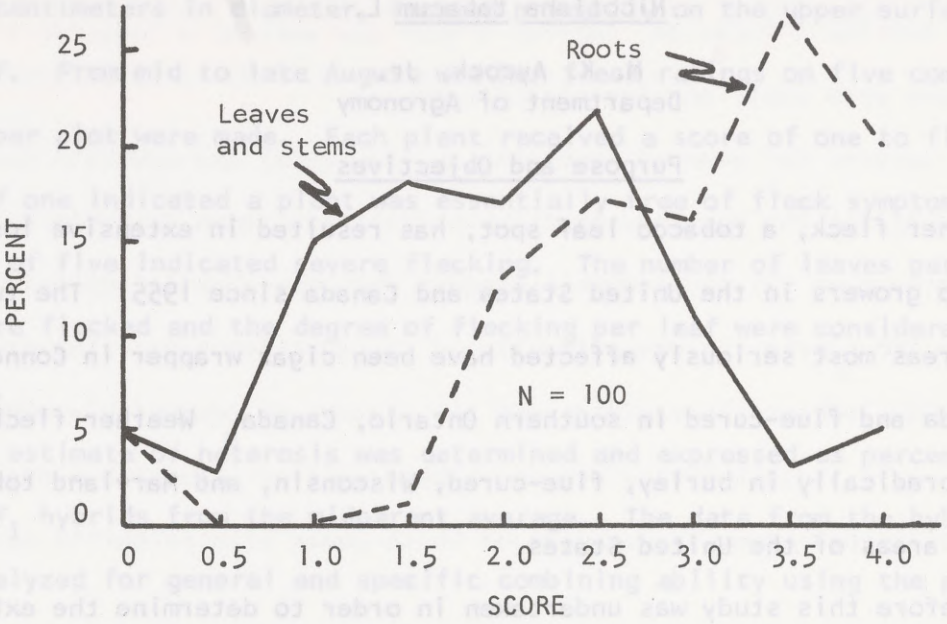


Figure 1. Frequency distribution of entries screened for black shank resistance; 0 = completely resistant and 4 = dead. (1971)

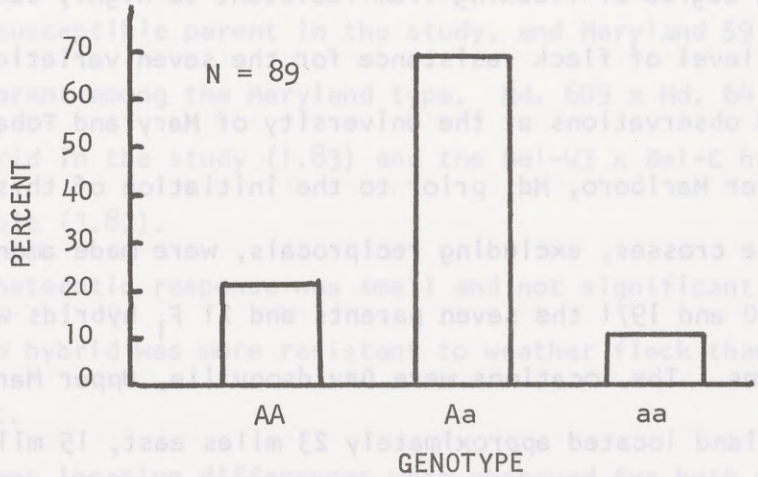


Figure 2. Percentage of resistant (AA), segregating (Aa), and susceptible (aa) genotypes screened for tobacco mosaic resistance. (1970)

Combining Ability Estimates for Weather Fleck in *Nicotiana tabacum* L.

M. K. Aycock, Jr.
Department of Agronomy

Purpose and Objectives

Weather fleck, a tobacco leaf spot, has resulted in extensive losses to tobacco growers in the United States and Canada since 1955. The two production areas most seriously affected have been cigar wrapper in Connecticut and Florida and flue-cured in southern Ontario, Canada. Weather fleck also occurs sporadically in burley, flue-cured, Wisconsin, and Maryland tobacco-producing areas of the United States.

Therefore this study was undertaken in order to determine the extent of genetic variability among several varieties of Maryland and cigar types of tobacco, to determine if heterosis was important for weather fleck, and to obtain estimates of general and specific combining ability.

Procedures

To obtain a broad gene base, four Maryland and three cigar tobacco varieties ranging in degree of flecking from resistant to highly susceptible, were used. The level of fleck resistance for the seven varieties was determined from field observations at the University of Maryland Tobacco Experimental Farm, Upper Marlboro, Md. prior to the initiation of this study.

All possible crosses, excluding reciprocals, were made among the seven parents. In 1970 and 1971 the seven parents and 21 F_1 hybrids were evaluated at three locations. The locations were Davidsonville, Upper Marlboro, and Dentsville, Maryland located approximately 23 miles east, 15 miles east-southeast, and 50 miles south-southeast of Washington, D. C., respectively. A randomized complete block design with three replications was used at each location. Each plot consisted of 10 plants.

The symptoms of weather fleck are small necrotic lesions, usually 0.2 to 0.5 centimeters in diameter, located primarily on the upper surface of the leaf. From mid to late August weather fleck ratings on five competitive plants per plot were made. Each plant received a score of one to five. A score of one indicated a plant was essentially free of fleck symptoms while a score of five indicated severe flecking. The number of leaves per plant that were flecked and the degree of flecking per leaf were considered in scoring.

An estimate of heterosis was determined and expressed as percent change of the F_1 hybrids from the midparent average. The data from the hybrids were analyzed for general and specific combining ability using the procedure outlined by Matzinger and Kempthorne.

Results

Mean weather fleck ratings for the seven parents and 21 F_1 hybrids for the two years are given in Table 1. Considerable variability was noted among parents and hybrids. Bel-B and Md. 64 were the most resistant parents to air pollution in the study, averaging 1.48 and 1.53, respectively. Bel-W3 was the most susceptible parent in the study, and Maryland 59 was the most susceptible parent among the Maryland type. Md. 609 x Md. 64 was the most resistant hybrid in the study (1.83) and the Bel-W3 x Bel-C hybrid was the most susceptible (3.82).

Average heterotic response was small and not significant for both years (Table 1). No hybrid was more resistant to weather fleck than the most resistant parent.

Significant location differences were observed for both years (Table 3). The amount of air pollution damage observed at Davidsonville and Upper Marlboro was similar, however damage was lower at Dentsville. The year to year

variation was not statistically significant. The parents and hybrids performed similarly over the total six environments, 3 locations for 2 years, since the entries x location, entries x year and entries x location x year interactions were small and not significant.

Mean squares for general combining ability (GCA) and specific combining ability (SCA) for the combined genetic analysis are shown in Table 2. Large GCA estimates over all environments suggest that the genetic variability present in the population was primarily of the additive type. The predominance of additive genetic variance and the absence of appreciable amounts of heterosis would suggest that a breeder should utilize selection procedures that would increase gene frequencies of those genes with primarily additive effects.

The lack of significant genotype x environment interactions suggest that the genetic material in this study was stable from one environment to another.

Summary

Seven varieties of tobacco (4 Maryland and 3 cigar types) and 21 F_1 hybrids were grown at 3 locations for 2 years. During August data were collected on leaf damage caused by air pollutants, primarily ozone. This condition is referred to as weather fleck. Ozone causes small necrotic lesions usually 0.2 to 0.5 cm in diameter. Plants were scored on a scale of 1 to 5 (1 = no damage, 5 = severe damage). Comparison of parent (2.34) and F_1 hybrid (2.37) performance indicated no significant amounts of heterosis for weather fleck. Diallel analyses of variance of the F_1 hybrid generation suggested an appreciable amount of variance due to general combining ability (GCA) and the absence of variance due to specific combining ability (SCA). Genetic effects were stable with respect to locations and years. The genotype x

environment interactions for the 6 environments were small and not significant. The predominance of additive genetic variance in this material, suggest that progress could be made through selection.

Table 1. Mean performance of 7 parents and 21 F_1 hybrids for weather fleck in tobacco grown at 3 locations for 2 years, 1970-71.

Parent or hybrid			Weather fleck score [a/]
Md. 10			1.87
Md. 59			2.36
Md. 609			1.80
Md. 64			1.53
Bel-W3			4.53
Bel-C			2.79
Bel-B			1.48
Md. 10	x	Md. 59	2.09
		Md. 609	1.84
		Md. 64	1.93
		Bel-W3	2.93
		Bel-C	2.39
		Bel-B	1.93
Md. 59	x	Md. 609	1.89
		Md. 64	2.04
		Bel-W3	3.39
		Bel-C	2.67
		Bel-B	2.23
Md. 609	x	Md. 64	1.83
		Bel-W3	2.79
		Bel-C	2.30
		Bel-B	1.92
Md. 64	x	Bel-W3	2.84
		Bel-C	2.19
		Bel-B	1.90
Bel-W3	x	Bel-C	3.82
		Bel-B	2.62
Bel-C	x	Bel-B	2.18
LSD (.05)			0.27
(.01)			0.36
Parent mean (P)			2.34
Hybrid mean (H)			2.37
Heterosis, %			1.28

[a/] Scores were 1 for no damage to 5 for severe damage.

Table 2. General and specific combining ability mean squares and interactions with locations and years for weather fleck in tobacco.

Source	D. F.	Mean Square
Hybrids	20	5.304 **
GCA	6	16.416 **
SCA	14	0.542
H x L	40	0.326
GCA x L	12	0.583
SCA x L	28	0.216
H x Y	20	0.296
GCA x Y	6	0.196
SCA x Y	14	0.339
H x L x Y	40	0.226
GCA x L x Y	12	0.262
SCA x L x Y	28	0.211

** Significant at the 1% level of probability.

Table 3. Location means for weather fleck in tobacco over 2 years, 1970-71.

Year	Location			Mean
	Davidsonville	Upper Marlboro	Dentsville	
1970	2.55	2.37	1.64	2.19
1971	3.13	2.63	1.85	2.53
Mean	2.84	2.50	1.74	2.36

Performance of Maryland Tobacco Varieties and Breeding Lines, 1970

M. K. Aycock, Jr.
Department of Agronomy

Purpose and Objectives

The Official Variety Test is the final phase of the breeding program and has three main objectives: (1) To obtain additional information on the varieties presently being grown by the majority of the tobacco farmers, (2) to evaluate advanced breeding lines which appear to have potential as a new variety, and (3) to provide a guide to southern Maryland tobacco farmers for use in choosing a variety to produce their best crop.

Procedures

Each year the variety tests are conducted at three locations with varying soil types. At Upper Marlboro, Davidsonville and Dentsville the tests are grown on Monmouth fine sandy loam, Galestown loamy sand and Beltsville silt loam soils, respectively.

The 1970 test which is included in the present report contained seven varieties and twelve breeding lines. Eight breeding lines in the test were developed by the USDA at Beltsville under the direction of H. A. Skoog. M61, M871, M872 and M881 were Agricultural Experiment Station entries.

Four replications of a randomized complete block design were used at each location. Each plot consisted of one row of 23 competitive plants. The plots were three feet apart and plants spaced two feet apart in the plot. Twenty competitive plants per plot were cut at harvest.

The various agronomic and chemical characteristics measured and methods of data collection have been outlined by Aycock et al., 1972, Md. Agr. Exp. Sta. Mis. Pub. 798.

Results

The average performance of the varieties and breeding lines compared at three locations in 1970 is shown in Table 1. Md. 64 was the highest yielding variety with 2002 pounds of cured leaf per acre. Md. 609 was the best quality variety with an average of $75.13 per hundredweight. Several breeding lines compared very favorably with the best varieties. J-69-101F-1 and J-69-201F-1 were similar to Md. 64 in yield and also gave a good dollar return per acre. M871 and M872 were slightly lower in yield than Md. 64, but produced a good quality leaf that was similar to Md. 609. Good yields and high quality for these two breeding lines resulted in a high dollar return per acre.

The varieties and breeding lines ranged from 1.16% (M872) to 1.91% (J-69-41F-1) for total alkaloids. Significant variation was noted also among most of the other agronomic and chemical traits measured. Several breeding lines compared very favorably with the standard varieties for these traits.

Summary

The variety testing program was conducted at three locations in 1969. Several breeding lines with multiple disease resistance appear to have a real potential as new varieties.

Table 1. Performance of Maryland tobacco varieties and breeding lines at three locations, 1970.

Variety or breeding line	Yield per acre (lbs.)	Value		Plant height (in.)	Leaves per plant	Internode length (in.)	Days to flower	Total alkaloids (%)	Total nitrogen (%)	Duration of burn (sec.)	Filling capacity (cc/g)
		$/A	$/cwt								
Catterton	1645	1201	72.94	31.5	19.1	1.64	57.5	1.41	2.75	9.96	7.55
Wilson	1973	1373	69.69	31.0	18.9	1.64	55.3	1.24	2.76	11.53	7.62
Gertz	1720	1230	71.69	32.2	19.3	1.67	55.8	1.64	2.80	9.52	7.22
Md. 59	1602	1159	72.24	34.0	17.8	1.91	55.7	1.52	2.80	12.65	7.65
Md. 609	1665	1246	75.13	32.2	17.8	1.80	58.0	1.46	3.09	9.70	7.19
Md. 64	2002	1384	69.34	31.5	20.0	1.57	58.8	1.26	2.74	10.57	7.56
Md. 10	1608	1171	72.78	33.2	18.8	1.76	56.2	1.27	2.51	12.50	7.96
M61	1880	1389	73.87	33.1	19.6	1.69	54.7	1.20	2.59	11.52	7.74
M871	1953	1466	75.11	34.7	18.9	1.84	58.4	1.36	3.00	8.50	7.33
M872	1905	1443	75.75	32.6	17.9	1.82	56.1	1.16	2.98	8.73	7.51
M881	1816	1342	73.99	35.5	17.9	1.98	56.6	1.31	2.84	10.68	7.53
J-69-2F-1	1861	1345	72.35	34.7	21.4	1.62	63.2	1.42	2.64	8.61	7.87
J-69-41F-1	1754	1326	75.58	32.2	18.1	1.78	57.2	1.91	2.74	5.83	7.57
J-69-42F-1	1837	1384	75.32	34.7	19.4	1.78	55.5	1.82	2.67	6.65	7.32
J-69-101F-1	2046	1455	71.08	32.6	18.8	1.74	57.2	1.37	2.75	10.15	7.43
J-69-201F-1	2014	1483	73.67	34.7	21.1	1.64	60.9	1.30	2.56	10.93	7.63
J-69-221F-1	1857	1334	71.81	34.8	19.8	1.76	56.8	1.17	2.67	10.17	7.65
J-69-253F-1	1829	1354	74.10	33.6	18.2	1.85	54.5	1.21	2.82	11.38	7.55
J-69-233F-1	1978	1436	72.73	37.4	20.6	1.82	63.0	1.40	2.78	12.31	7.48
Mean	1839	1343	73.11	33.5	19.1	1.75	57.4	1.39	2.76	10.10	7.55
L.S.D. (.05)	159	120	1.74	2.2	1.2	0.06	2.8	0.52	N.S.	3.37	N.S.
(.01)	214	161	2.33	3.0	1.6	0.09	3.7	0.70	N.S.	N.S.	N.S.
C.V. (%)	9.1	9.3	2.1	7.9	6.5	5.0	3.5	18.8	10.9	29.8	6.7

The Effects of the *Nicotiana megalosiphon* Source of Cytoplasmic Male-sterility in Maryland Tobacco

M. K. Aycock, Jr.
Department of Agronomy

Purpose and Objectives

Success of hybrids in certain crop plants in recent years has been possible because the increased productiveness and/or uniformity of the hybrids over standard varieties, have exceeded the increased cost of producing hybrid seed. Cytoplasmic male-sterility has greatly facilitated the commercial utilization of hybrids by eliminating the necessity for emasculation of seed parents. Today, cytoplasmic male-sterility is being used to produce hybrids on a commercial scale in a number of crops.

The objectives of this investigation were: (1) to determine the effects of the *Nicotiana megalosiphon* source of male-sterility on certain agronomic and chemical traits of Maryland tobacco, and (2) to determine the potential use of this source of male-sterility in producing hybrid seed.

Procedures

The male-sterile, flue-cured variety 402 with *N. megalosiphon* cytoplasm was obtained from Dr. E. A. Wernsman at North Carolina State University. In 1965 one plant of the male-sterile 402 line was crossed by five plants, one from each of five Maryland varieties. These varieties were Catterton, Gertz, Md. 59, Md. 609, and Md. 64. The first generation hybrids were grown in the breeding nursery during the summer of 1967. A backcross program then was initiated using the five Maryland varieties as the recurrent parents.

In 1969, the five male-sterile varieties and 10 male-sterile F_1 hybrids were evaluated with their fertile counterparts in a field experiment at the University of Maryland Tobacco Experimental Farm. For this study, the Catter-

ton, Gertz, and Md. 609 male-sterile varieties were in the BC_4 and Md. 59 and Md. 64 in the BC_3 generation. Eight of the male-sterile hybrids were in the BC_3F_1 and two involving Md. 59 as the seed parent were in the BC_2F_1 generation.

A randomized split-plot design with three replications was used. Families, varieties or hybrids, comprised the whole plots and their position within each block was chosen at random. The whole plots were divided into two subplots with the male-sterile and fertile components being randomly assigned. Each subplot consisted of a single row containing 23 competitive plants.

Results

This report will consider three comparisons: (1) Varieties versus (vs.) hybrids, (2) male-steriles vs. male-fertiles, and (3) male-fertile varieties vs. male-sterile hybrids. The third comparison combines both hybridization and male-sterility and compares the present method of variety production with a possible new method, i.e., male-sterile hybrids.

The agronomic and chemical data for the three comparisons are presented in Table 1. No significant heterotic response was observed for any of the agronomic and chemical traits studied. However, the depressing effects of the male-sterile factor were evident for most traits. The male-steriles were lower in yield, value, plant height, leaves per plant, and internode length, flowered later, were higher in total nitrogen, and had less weather fleck damage than the male-fertiles. The depressing effects of male-sterility were greater than hybridization since when the two were combined, the response for the male-sterile hybrids as compared to the male-fertile varieties was similar to the male-sterile vs. male-fertile comparison.

Five weekly rates of growth were calculated from six weekly plant height measurements. For example, the difference obtained between the first and

second weekly plant height measurements was considered the first growth rate increment. Data for the five weekly growth increments are shown in Table 2. The varieties and hybrids grew about the same throughout the growing season. However, the male-steriles had a slower growth rate than the male-fertiles for the first four growth periods (21 to 50 days after transplanting). Also the male-sterile hybrids grew slower than the male-fertile varieties during the early part of the growing season.

Summary

No significant heterotic response was found for the various agronomic and chemical traits studied. However, the male-steriles were lower in yield, value and plant height, had fewer leaves per plant, a higher total nitrogen content and less weather fleck damage, flowered later, and grew slower than the male-fertiles. The depressing effects of male-sterility when observed with hybridization were similar to those observed with male-sterility alone. Therefore the depressing effects of the N. megalosiphon source of male-sterility appear to offset any advantages of hybrids over the standard varieties.

Table 1. Agronomic performance of varieties, hybrids, male-steriles, male-fertiles, male-sterile hybrids, and male-fertile varieties of Maryland tobacco.

Comparison	Yield (kg/ha)	Value ($/kg)	Plant height (cm)	Leaves per plant	Internode length (cm)	Days to flower	Total alkaloids (%)	Total nitrogen (%)	Filling value (cc/g)	Weather fleck (1-5)
Varieties (V)	1924	1.38	98.9	21.2	4.67	66.5	0.88	2.82	6.71	2.69
Hybrids (H)	1952	1.42	100.0	21.3	4.71	66.1	0.88	2.88	6.74	2.63
Heterosis (%)	1.4	2.9	0.1	0.5	0.8	-0.6	0.0	2.1	0.4	-2.2
Male-fertiles (MF)	2082	1.44	103.7	21.9	4.74	63.6	0.89	2.79	6.76	2.84
Male-steriles (MS)	1804	1.37	95.6	20.6	4.66	68.9	0.88	2.94	6.70	2.47
MS depression (%)	13.3**	4.9**	7.8**	5.9**	1.7*	-8.3**	1.1	-5.4*	0.9	13.0**
MF Varieties	2052	1.39	102.6	22.0	4.68	63.6	0.90	2.76	6.75	2.79
MS Hybrids	1808	1.37	95.9	20.6	4.65	68.6	0.88	2.96	6.72	2.40
Difference (%)	11.9**	1.4	6.5**	6.4**	0.6	-7.9**	2.2	-7.2*	0.4	14.0**

*, ** Significant at the .05 and .01 levels of probability, respectively.

Table 2. Weekly growth increments in centimeters of varieties, hybrids, male-steriles, male-fertiles, male-sterile hybrids, and male-fertile varieties of Maryland tobacco.

Comparison	Days after transplanting				
	21 to 28	28 to 35	35 to 42	42 to 50	50 to 77
Varieties	7.0	8.3	13.8	21.5	37.9
Hybrids	7.0	7.8	14.4	22.7	39.2
Heterosis (%)	0.0	-6.0	4.3	5.6	3.4
Male-fertiles (MF)	8.4	8.6	15.3	23.8	37.1
Male-steriles (MS)	5.6	7.3	13.0	20.9	40.4
MS depression (%)	33.3**	15.1*	15.0**	12.2**	-8.9*
MF Varieties	8.2	9.3	14.6	22.8	36.5
MS Hybrids	5.6	7.4	13.1	21.2	40.9
Difference (%)	31.7**	20.4*	10.3	7.0	-12.0*

*, ** Significant at the .05 and .01 levels of probability, respectively.

Variations Among Plant Selections of the Maryland 59 Tobacco Variety

M. K. Aycock, Jr.
Department of Agronomy

Purpose and Objectives

Improvement of tobacco varieties generally involves the pedigree or backcross method of breeding. Once a new homozygous variety is released, no further changes would be expected except through mutations. These changes occur at a very low frequency, but sometimes may be beneficial in variety improvement.

Md. 59 was released in 1965. It has excellent quality, black shank resistance, and a number of other desirable traits, but does not have the yielding ability of the other more popular varieties. Therefore it was of interest to evaluate a number of plant selections within the Md. 59 variety to see if any useable genetic variation was available for increasing yield.

Procedures

Seed from nine bagged Md. 59 plants grown in the tobacco breeding nursery in 1970 were used as source material for this study. The plants were bagged to insure self-pollination. Seed from the nine plants were maintained separately and comprised the nine entries.

The nine entries were grown in a randomized block design with four replications at the University of Maryland Tobacco Experimental Farm in 1971. Each plot consisted of one row of 25 plants spaced two feet apart. The plot spacing was three feet.

Six agronomic and chemical traits were measured. They were yield per acre, value per acre, value per hundredweight, days to flower from transplanting, total alkaloids, and total nitrogen.

Results

Agronomic and chemical data for the nine plant selections are shown in Table 1. No significant amount of variation was observed for any of the traits measured.

Summary

No useable genetic variation was found among the nine plant selections in the Md. 59 variety. Therefore, the pedigree method appears to be the most useful breeding tool to utilize in attempting to increase yield of this variety.

Table 1. Agronomic and chemical data for nine plant selections (head-to-row) of the Md. 59 tobacco variety, 1971.

Entry	Yield per acre (lbs.)	Value		Days to flower	Total alkaloids (%)	Total nitrogen (%)
		$/A	$/cwt			
Md. 59-1	1562	1182	75.71	52.0	1.73	2.40
Md. 59-2	1486	1138	76.51	52.8	1.54	2.40
Md. 59-3	1445	1096	75.82	51.2	1.65	2.30
Md. 59-4	1517	1160	76.48	53.0	1.65	2.41
Md. 59-5	1573	1200	76.24	53.0	1.57	2.44
Md. 59-6	1530	1167	76.26	52.8	1.64	2.42
Md. 59-7	1568	1184	75.57	53.8	1.54	2.43
Md. 59-8	1470	1119	76.14	52.8	1.76	2.37
Md. 59-9	1481	1137	76.68	53.2	1.63	2.35
Mean	1515	1154	76.16	52.7	1.64	2.39
L.S.D. (.05)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
C.V. (%)	5.3	5.8	0.8	3.6	12.0	5.8

Varietal Response to Mechanical Harvesting in Maryland Tobacco

M. K. Aycock, Jr., P. N. Winn, Jr., and H. A. Skoog
Departments of Agronomy and Agricultural Engineering,
and the U. S. Department of Agriculture

Purpose and Objectives

Production and labor costs for Maryland tobacco continue to increase. Mechanization of various production practices tend to decrease these costs and make the physical work easier. The development of a tobacco harvester by the Agricultural Engineering Department has reduced the work of harvesting by as much as 20 percent. However, the response of the various varieties with differing physical traits is not known. Therefore, this study was undertaken with the following objectives: (1) To compare mechanical harvesting with the standard hand method, (2) To determine the amount of genetic variability that exists among the various varieties and breeding lines, (3) To determine if the varieties would respond differently when harvested by the two methods, and (4) To determine if there were any significant relationships among the various agronomic traits that may aid the plant breeder in developing new varieties of Maryland tobacco.

Procedures

Seven standard varieties (Catterton, Wilson, Gertz, Md. 59, Md. 609, Md. 64, and Md. 10) and two breeding lines (J-69-42F-1 and J-69-101F-1) were included in the study.

This study was grown for two years, 1969 and 1970, at the University of Maryland Tobacco Experimental Farm, Upper Marlboro, Md. A split-plot design with three replications was used each year. The two whole-plots within each replication were methods of harvest: mechanical and hand. The nine subplots within each whole-plot were composed of seven varieties and two breeding lines.

Each subplot consisted of a single row containing 16 competitive plants. The plants were spaced two feet apart in the row and the rows were three feet apart.

Data were obtained on twelve agronomic traits during the course of the study. Five traits were measured prior to harvest (pre-harvest traits) and seven were measured after harvest (post-harvest traits).

Phenotypic correlations were calculated on all plot values for the two years, n = 108.

Results

Pre-harvest Traits

Since the four leaf measurements and days to flower were taken prior to harvest, no differences would be expected for harvest methods. This was the case for these five agronomic traits (Table 1). However, considerable genetic variability was present among the seven varieties and two breeding lines.

Year to year variation for certain agronomic traits is common. In this study, longer and larger leaves with a greater angle of attachment were observed in 1969. No differences were noted for leaf width and days to flower.

Post-harvest Traits

The two-year averages for the seven agronomic traits measured after harvest are shown in Table 2. The machine harvested plots were lower in quality ($/cwt), had a higher leaf loss and leaf count per plant, and were taller than the plots harvested by the conventional hand method. There was a trend for lower yield and dollar return per acre with machine harvesting but these differences were not significant statistically.

Genetic variability also existed among the varieties and breeding lines for all post-harvest traits.

Phenotypic Correlations

Phenotypic correlations among the seven post-harvest agronomic traits are presented in Table 3. Increased yield of cured leaf appeared to be associated with taller plants, high leaf counts and closely spaced leaves on the stalk. However as yield, plant height and leaf count increases so does the amount of leaf loss. Dollars per acre also were positively correlated with yield and quality. Generally, quality was negatively correlated with the other traits. Increased quality appears to be associated with less leaf loss, shorter plants and internodes, and lower leaf count.

Summary

Seven Maryland tobacco varieties and two breeding lines were used to evaluate mechanical harvesting with the conventional hand method. Plants harvested by machine were lower in quality, taller in height, and had more leaves and a greater amount of leaf loss per plant than when harvested by hand. No significant differences were observed between the two harvest methods for yield and value per acre.

Considerable genetic variability was found among the varieties and breeding lines for the 12 pre- and post-harvest agronomic traits measured. Using the available genetic variability and relationships in a breeding program for developing new varieties adapted to mechanical harvest appear feasible.

Table 1. Pre-harvest performance of Maryland tobacco varieties and breeding lines when harvested by hand and machine, 1969-70.

Variety or breeding line	Leaf length (cm)	Leaf width (cm)	Leaf angle (°)	Leaf area (cm^2)	Days to flower
Catterton	70.8	29.4	44.7	1327	56.9
Md. 10	68.0	29.4	46.3	1276	58.1
Wilson	71.4	33.8	39.9	1550	58.0
Gertz	71.9	30.2	43.2	1382	56.7
Md. 59	69.8	32.9	36.8	1464	54.6
Md. 609	72.6	32.8	38.1	1516	59.2
Md. 64	73.1	30.5	39.0	1429	61.6
J-69-42F-1	69.2	29.5	40.6	1299	59.2
J-69-101F-1	74.6	35.9	36.3	1707	61.2
Mean	71.3	31.6	40.5	1439	58.4
L.S.D. (.05)	3.0	1.9	3.7	134	1.8
(.01)	3.9	2.6	5.0	178	2.4
Hand Harvest	71.4	31.7	40.6	1447	58.0
Machine Harvest	71.1	31.4	40.5	1431	58.8
Hand vs. Machine	N.S.	N.S.	N.S.	N.S.	N.S.
1969	73.8	33.2	45.6	1561	59.7
1970	68.7	30.0	35.5	1317	57.1
1969 vs. 1970	*	N.S.	*	*	N.S.

* Significant at the 5% level of probability.

Table 2. Post-harvest performance of Maryland tobacco varieties and breeding lines when harvested by hand and machine, 1969-70

Table 2. Post-harvest performance of Maryland tobacco varieties and breeding lines when harvested by hand and machine, 1969-70.

Variety or breeding line	Yield per acre (lbs.)	Value ($/A)	Quality ($/cwt)	Leaf loss per plant	Plant height (cm)	Leaves per plant	Internode length (cm)
Catterton	1383	871	62.84	0.38	89.2	21.2	4.20
Md. 10	1293	823	63.89	0.45	92.0	20.7	4.42
Wilson	1618	1020	63.35	0.60	82.0	19.6	4.16
Gertz	1390	910	65.56	0.75	84.8	19.5	4.32
Md. 59	1294	859	66.58	0.58	93.1	18.9	4.93
Md. 609	1448	1025	70.70	0.75	91.2	19.4	4.69
Md. 64	1772	1125	63.93	0.65	87.4	21.6	4.02
J-69-42F-1	1431	996	69.72	0.72	87.2	19.7	4.43
J-69-101F-1	1898	1208	63.80	0.80	85.9	20.0	4.27
Mean	1503	982	65.60	0.63	88.1	20.1	4.38
L.S.D. (.05)	153	134	3.54	0.22	5.1	1.2	0.15
(.01)	203	178	4.71	0.29	6.8	1.5	0.20
Hand harvest	1550	1026	66.71	0.43	86.6	19.6	4.43
Machine harvest	1456	938	64.48	0.83	89.6	20.6	4.34
Hand vs. machine	N.S.	N.S.	*	**	*	*	N.S.
1969	1659	1000	60.33	1.01	100.7	22.2	4.54
1970	1347	964	70.87	0.25	75.5	17.9	4.22
1969 vs. 1970	N.S.	N.S.	*	**	**	**	N.S.

* Significant at the 5% level of probability.
** Significant at the 1% level of probability.

Table 3. Phenotypic correlations for the seven post-harvest agronomic traits measured in the mechanical harvesting study in Maryland tobacco, df = 106.

Agronomic traits	Value ($/A)	Quality ($/cwt)	Leaf Loss per plant	Plant height	Leaves per plant	Internode length
Yield, lbs/A.	.87 **	-.15	.42 **	.32 **	.54 **	-.23 *
Value, $/A		.35 **	.14	.03	.25 **	-.34 **
Quality, $/cwt			-.52 **	-.58 **	-.54 **	-.24 *
Leaf loss				.61 **	.59 **	.21 *
Plant height					.84 **	.56 **
Leaves per plant						.04

* Significant at the 5% level of probability.
** Significant at the 1% level of probability.

Leaching of Nitrate Nitrogen from Several Fertilizer Sources When Applied to Soils of Various Textures

V.A. Bandel and C.E. Rivard
Department of Agronomy

Purpose and Objectives

Of the approximately 350,000 acres of small grain produced in Maryland each year, experience has indicated that nearly 50 percent should be topdressed with from 20 to 100 lb/A of nitrogen for maximum profits and top yields. Unfortunately, in late February or early March when it is recommended that nitrogen be applied, fields are often wet or soft and difficult to cross with fertilizer spreading equipment. There would be a distinct advantage if a slow release fertilizer could be applied in the fall to eliminate the spring topdressing. On other crops where large amounts of nitrogen are required for maximum yields, leaching losses have frequently been believed to be serious. The objectives of this work were therefore to:

1. Compare the effect of rate and time of application of sulfur-coated urea and several other forms of nitrogen on growth and yield of small grains on light textured soils.
2. Compare residual effects of sulfur-coated urea and other nitrogen forms for corn production.
3. Determine relative leaching losses of sulfur-coated urea and other nitrogen forms on various textured soils.

Procedure

Small Grains. A 3x6 randomized factorial design was replicated four times. Sulfur-coated urea, ammonium nitrate and urea were applied at 60 lbs. N/A. A no nitrogen plot was included for each source as a check, and the remaining plots were given a nitrogen application at one of five dates

spaced approximately five weeks apart through the season. Blueboy wheat was used as the test crop at the Poplar Hill and Plant Research Farms and Barsoy barley was used at the Forage Farm in the 1970-71 season. The soil types were Galestown loamy sand, Beltsville silt loam, and Chester silt loam at the Poplar Hill, Plant Research and Forage Research Farms, respectively.

Corn. A 3x5 randomized factorial design was replicated four times at the Wye Institute and at the Poplar Hill farm on a Bertie silt loam and a Galestown loamy sand, respectively. Sulfur-coated urea, nitrate of soda and urea were applied and plowed down at 0, 60, 120, 240 and 480 lbs. of nitrogen per acre. The corn variety Pioneer 3369A was used for the test crop at both locations. Silage yields were taken in August and whole plant samples were analyzed for N, P, K, Ca, and Mg, using the University of Maryland Soil Testing Laboratory facilities (ref. Agronomy Mimeo 53). Soil samples were taken to a depth of 48 inches in 6 inch increments and tested for nitrate nitrogen using an automated technique,[1/] and for P, K, Ca and Mg using the Soil Testing Laboratory facilities (ref. Agronomy Mimeo 37). Soil samples were taken every other week at each location from March (before fertilization) through September and then once a month after harvest. Grain yields were determined by harvesting the center two rows of the six row plots. Statistical analysis of the data was done using the UNIVAC 1108 computer at the University of Maryland Computer Science Center. Free computer time is gratefully acknowledged.

Results

Small Grains. Grain yield differences on the heavier soils at the Plant

1/ Personal communication with Dr. J.E. Steckel, Rutgers University, New Brunswick, New Jersey.

Research and Forage Research farms were not affected by N source or time of application. However, at the Plant Research farm, N applications significantly increased yields compared to no N applied. On the sandy soil at Poplar Hill, applied N significantly increased yields compared to the check. The March 10 application resulted in significantly higher yields than the February 3 application. Urea and ammonium nitrate produced greater yield increases than did sulfur-coated urea.

Corn. Silage and grain yields at the Wye Institute were not significantly different between the three sources of nitrogen or between the four application rates. However, yields were significantly increased compared to the check when nitrogen was applied at any of the four application rates used.

Yields at Poplar Hill indicated that significantly more silage was obtained from sulfur-coated urea than from nitrate of soda (Table 1). However, the differences in grain yields between the three sources were not significant (Table 2). Comparisons between application rates indicated that silage and grain yields were not significantly different for N rates of 120 lbs/A or higher. Grain yields increased significantly between the check and 50 lbs/A and again between the 60 and 120 lbs/A rates. Silage yields also indicated a significant increase between the check and 60 lbs. N/A rate. Slight increases in silage yields resulted from heavier N rates, but only the 240 lb. N rate produced significantly more silage than the 60 lb. rate.

Summary

Sulfur-coated urea, nitrate of soda and urea were compared top-dressed on small grains and plowed down on corn. A time of application study on wheat indicated that yields were not significantly higher when topdress N was applied in early spring as compared to fall and winter.

But there was a trend indicating slightly higher yields from the spring application and possible N loss from the soluble sources applied in the fall. Lower yields resulting from the sulfur-coated urea treatments indicated that N release rates from this slow-release fertilizer were insufficient for maximum yields at the 60 lbs. N/A application rate.

Average corn grain and silage yields were lower for nitrate of soda than for urea and sulfur-coated urea due to yield depressions at the highest rates. The highest yields were obtained from sulfur-coated urea at N rates found to be excessive if applied as urea or nitrate of soda. This suggested that only a part of the N applied as sulfur-coated urea was being released in time to produce a yield response.

Table 1. Corn Silage Yields at Poplar Hill, Wicomico Co. Md. 1971, as Affected by N Source and Rate of Application.

N rate lbs/A	Source S.C.U.*	N.S.*	UREA	Average
	tons/A yield			
0	12.1	12.1	12.1	12.1 a#
60	22.3	15.3	16.5	18.0 b
120	18.3	22.0	21.2	20.7 bc
240	22.7	19.1	22.0	21.3 c
480	22.3	16.4	19.3	19.3 bc
Average	19.8 b	16.8 a	18.4 b	18.3

* S.C.U. = sulfur coated urea, and N.S. = nitrate of soda
\# Averages accompanied by the same letter are not different at the 5% level as indicated by Duncan's multiple range test.

Table 2. Corn Grain Yields at Poplar Hill, Wicomico Co. Md. 1971, as Affected by N Source and Rate of Application.

N rate lbs/A	Source S.C.U.*	N.S.*	UREA	Average
	tons/A yield			
0	58.1	58.1	58.1	58.1 a#
60	105.7	90.6	96.8	97.7 b
120	120.8	139.1	133.2	131.0 c
240	137.5	121.3	142.0	133.6 c
480	147.6	113.8	124.9	128.8 c
Average	114.2 a	104.6 a	110.8 a	109.8

* S.C.U. = sulfur coated urea, and N.S. = nitrate of soda
\# Averages accompanied by the same letter are not different at the 5% level as indicated by Duncan's multiple range test.

Soil Test - Plant Analysis Correlation

V.A. Bandel
Department of Agronomy

Purpose and Objectives

Soil testing continues to be one of the best diagnostic tools available to farmers, homeowners, and others for analyzing soil and plant nutritional problems. The soil test values are meaningless for making lime and fertilizer recommendations, however, unless the results have been properly correlated with plant response. The objectives of this experiment were 1) to observe the effects of nitrogen fertilization on corn yields, percent nitrogen in the plant, and soil pH, 2) to observe the effects of phosphorus fertilization on corn yields, phosphorus content of the plant, and phosphorus soil test level, 3) to observe the effects of potassium fertilization on corn yields, potassium content of the plant, and soil test potassium level, and 4) to correlate soil test and plant analysis results with yields and utilize the results as a basis for improved lime and fertilizer recommendations.

Procedure

This project was conducted on a Bertie silt loam soil at the Wye Institute, Queenstown, Maryland. In three separate tests, replicated four times, fertilizer was applied each year in the spring before plowing. Plow down treatments were as follows (lb/A N - P_2O_5 - K_2O):

Nitrogen test	Phosphorus test	Potash test
0-160-160	170-0-150	170-100-0
30-160-160	170-120-150	170-100-20
60-160-160	170-40-150	170-100-40
120-160-160	170-80-150	170-100-80
240-160-160	170-160-150	170-100-160

Corn was planted uniformly in 30 inch rows with a small amount of starter

fertilizer (10-20-20) in the row for all treatments. Ear leaf samples were taken each year at tasseling time. Following the grain harvest, a soil sample was taken from each plot in late October or early November. Through 1971, on the four nitrogen check plots, soil samples were taken at monthly intervals.

Results

In 1971, contrary to what occurred in 1970, it was observed that soil pH values on the nitrogen check plots were consistently 0.1 pH unit higher for all nitrogen treatments than reported in 1970. This, of course, may have been due to experimental error, or it could have been due to a slight difference in time of soil sampling from one year to another (Table 1). Based upon an average of four test results each month over a period of one year, the soil pH varied as much as 0.4 of a unit. Soil pH levels tended to be lowest during the active growing season from April to July. This may have been due to the presence of more acid forming fertilizers as well as the metabolic activity of the plant. Highest pH values occurred in February and March.

Corn ear leaf nitrogen content increased with nitrogen treatment from 1.3 to 2.6% (Table 2). In contrast to the 1970 results, where maximum yields occurred with the addition of 30 lbs. of nitrogen per acre, in 1971 yields increased by over 66 bu/A (from 34.2 bu/A with no N plowed down) with the addition of 120 lbs. N/A increased yields significantly. There was no further significant increase in yields with additional nitrogen over 120 lbs./A.

In 1970, the results indicated that maximum yields were obtained when ear leaf nitrogen levels were about 2.1% or higher. The 1971 soil test results support this observation with maximum yields being obtained when the ear leaf nitrogen content reached about 2.4%. This is still slightly

lower than the 2.7 - 3.5% currently being used as a normal range when interpreting plant analysis results.

Increasing the phosphorus fertilization rate tended to increase soil test phosphorus levels (Table 3), although soil phosphorus levels on these plots are already in the high soil test range. Perhaps because of the high soil phosphorus levels, increasing rates of phosphorus fertilization had very little effect upon yearly phosphorus content and no effect upon grain yield. Yearly phosphorus percentages ranged from 0.32 to 0.36%. This falls within the 0.25 to 0.30% phosphorus range considered normal when interpreting corn ear leaf analyses.

Increasing potassium fertilization treatments tended to increase soil potassium levels and ear leaf potassium contents. Ear leaf potassium levels ranged from 1.4 to 2.0%, which is slightly lower than the 1.8 to 2.5% currently considered normal. Potassium fertilization levels had no significant effect upon corn grain yields.

Summary

Nitrogen fertilization increased corn grain yields to a maximum where 120 lbs. N/A had been applied. Additional nitrogen did not further increase grain yields. Nitrogen fertilization increased ear leaf nitrogen levels and reduced the soil pH. Phosphorus fertilization increased soil phosphorus levels but had little or no effect upon ear leaf phosphorus or grain yield. Potassium fertilization increased soil potassium levels as well as ear leaf potassium, but had no effect upon grain yields.

These tests indicate that corn being produced on soils having medium phosphorus and potassium soil test levels are not likely to respond significantly to the additional application of phosphorus and potassium. It was also demonstrated that soil pH levels varied as much as 0.4 of a pH unit from the active growing season when pH values reached a minimum to

late winter when pH values reached a maximum. This could be an important consideration in cases where soil tests are taken from farmers' fields at different times of the year. These comparisons will be continued, at least in part, for several more years in an effort to reduce residual soil fertility levels to better correlate soil test and plant analysis results with plant response.

Table 1. Influence of Time of Sampling on Soil pH. 1971.

	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Soil pH[1/]	6.0	6.2	6.2	5.8	5.9	5.9	5.8	6.0	6.2	6.0	6.1	6.0

1/ Average of 4 replications.

Table 2. Influence of Nitrogen Rate on Soil pH, Corn Ear Leaf Nitrogen Content and Grain Yields. 1971.

	Nitrogen Rate (lb/A)				
	0	30	60	120	240
Soil pH (Fall)	6.0	5.8	5.9	5.8	5.6
Ear Leaf N - %	1.3	1.7	2.0	2.4	2.6
Corn Yield - Bu/A	34.2	59.1	74.9	100.7	102.4

Table 3. Influence of Phosphorus and Potash Rates on Available Soil Phosphorus and Potash, Corn Ear Leaf Phosphorus and Potassium Content, and Grain Yields. 1971.

	P_2O_5 and K_2O Rate (lb/A)				
	0	20	40	80	160
Soil P_2O_5 - lb/A[1/]	149 H	145 H	148 H	181 H	224 H
Ear Leaf P - %	0.32	0.33	0.33	0.36	0.36
Grain Yield - Bu/A	104.2	107.2	112.3	119.7	110.9
Soil K_2O - lb/A[1/]	85 M	96 M	110 M	128 M	179 M
Ear Leaf K - %	1.4	1.6	1.9	1.8	2.0
Grain Yield - Bu/A	112.8	106.9	105.0	111.8	101.7

1/ Extracted with 0.05 N HCl and 0.025 N H_2SO_4.

The Response of Corn to Fall Vs. Spring Plowing and Fertilization when Treated with Urea and Nitrate of Soda

V.A. Bandel
Department of Agronomy

Purpose and Objectives

When this project was initiated several years ago the main concern was whether or not fall nitrogen fertilization of corn would be economical. Today, the concern is not so much fertilizer economics but environmental protection from the effects of possible nitrogen fertilizer loss through leaching. The objectives of this experiment are to compare the effects of the following variables upon corn yields and nutrient recovery:

1. Fall vs. spring plow-down of urea and nitrate of soda.
2. Fall vs. spring plowing.
3. Several rates of urea plow-down in the fall and in the spring.
4. Nitrate of soda vs. urea plow-down in the fall and in the spring.

Procedure

In 1971, this project was conducted at three locations - 1. the Wye Institute, Queenstown, 2. Worcester Vocational Center, Snow Hill, and 3. George Redman Farm, Chestertown. The soil type at each location respectively was Bertie silt loam, Mattapeake loam, and Butlertown loam. Two sources of nitrogen, urea and nitrate of soda in a complete fertilizer were broadcast and plowed-down in a replicated split-plot design. The subplots within each main plot included urea at rates of 0, 55, 110, and 165 lbs. N/A, and nitrate of soda at 110 lbs. N/A. Phosphate (P_2O_5) and Potash (K_2O) were applied uniformly to all plots at a rate of 120 lbs/A. All plots received a small uniform starter fertilizer application in the row at the time of planting. The fall-applied fertilizer was broadcast soon after the previous corn crop had been harvested. This normally occurred

in late October or early November. The spring fertilizer was applied in late February or early March. The spring fertilizer treatment was applied as soon as the ground was in shape to plow and, of course, just prior to plowing.

Results

The results obtained in 1971 reflect the effects of three consecutive years of identical treatments on exactly the same locations. The grain yields obtained at the three locations are given in Table 1. At no location was there any significant difference in average yields between fall and spring applications of nitrogen. However, in all cases there was a significant positive response to nitrogen rate of application. Also, at two locations, Wye Institute and Worcester Vocational Center, there was a significant interaction between time of plowing and rate of nitrogen application. No such interaction occurred on the Butlertown soil in Kent County. This interaction indicated that on the Bertie and the Mattapeake soils an increase in yields was obtained from the fall plowing. Apparently any yield reductions occurring as a result of loss of fall-applied nitrogen were masked partially by the beneficial effect due to the fall plowing. This was particularly obvious on the Mattapeake soil in Worcester County. At this location, where no nitrogen was applied, the fall-plowed plot yielded 17.6 bu/A more than the spring-plowed plots. Where 55 lbs. N/A were plowed-down, fall-plowed plots yielded 11.5 bu/A more than the spring-plowed plots. At 110 lbs. N/A, the spring-plowed plot yielded 11.1 bu/A more than the fall-plowed plot. At 165 lbs. N/A, the spring-plowed plot yielded 19.4 bu/A more than the fall-plowed plot.

A look at the dry matter yields and the total nitrogen recovered by the corn at Wye Institute (Table 2) indicate that fall plowing on the Bertie soil increased the amount of the available nitrogen recovered by the plants

by about 56.9%. Similarly, on the Mattapeake soil in Worcester County (Table 3) fall plowing apparently increased the amount of nitrogen recovered by the plant by 69.5%. A similar response did not occur on the Butlertown soil in Kent County (Table 4).

Apparently, the extra nitrogen made available by the fall plowing, at two locations, masked the greater nitrogen losses from the fall applied nitrogen. The yield advantage gained from the fall plowing operation were overcome by the spring-applied nitrogen when the rates of spring-applied nitrogen had been increased sufficiently.

Summary

On the average, corn yields were not significantly reduced by fall applications of the complete fertilizer containing nitrogen. However, at two locations, there was a significant interaction between nitrogen application rate and time of plowing. At these two locations, fall plowing apparently increased the amount of nitrogen available to the plants by 50 to 60%. This resulted in the average yields from the fall and the spring nitrogen applications being not significantly different. However, when heavier nitrogen applications were made, yields and nitrogen recovery from the spring-plowed plots were higher than from the fall-plowed plots. This indicated that a significant amount of nitrogen could be lost by leaching or other means when applied for corn in the fall of the year. Often such differences are not obvious in the field in tests which are conducted for only one or two years. In this test, residual soil nitrogen almost completely masked the effects of the nitrogen treatments the first two years. By the third year, residual soil nitrogen levels had been depleted sufficiently so that the effects of the treatments could be observed. These tests will be conducted for at least four consecutive years on exactly the same areas in an effort to more completely deplete residual

soil nitrogen levels so that nitrogen responses can be more readily detected by grain yields and nutrient recovery.

Table 1. Influence of Nitrogen Rate, Source and Time of Application on Corn Grain Yields at Several Locations. 1970-71.

Fertilizer Plow-Down Time	N lb/A					
	0	55	110	165	110[1/]	Ave.[2/]
	Bu/A (15.5% H_2O)					
	Wye Institute					
Fall	53.5	85.9	100.8	95.8	98.0	86.8
Spring	25.2	70.4	98.1	100.3	105.5	79.9
Ave.[3/]	39.3	78.1	99.4	98.0	101.7	
	Worcester Vocational Center					
Fall	98.4	121.8	115.7	113.4	113.4	112.5
Spring	80.8	110.3	126.8	132.8	123.3	114.8
Ave.[4/]	89.6	116.0	121.3	123.1	118.3	
	George Redman Farm, Kent County					
Fall	69.0	101.4	112.6	127.3	123.8	106.8
Spring	67.7	112.7	128.8	132.6	125.8	113.5
Ave.[5/]	68.4	107.0	120.7	129.9	124.8	

1/ N from nitrate of soda this treatment only. N from urea all other plots.

2/ No significant difference between average fall and spring applications.

3/ Least Significant Difference (5% level) = 14.0 Bu.

4/ Least Significant Difference (5% level) = 19.5 Bu.

5/ Least Significant Difference (5% level) = 14.8 Bu.

Table 2. Influence of Nitrogen Rate, Source and Time of Application on Corn Total Dry Matter Yields and Total Nitrogen Recovery at Wye Institute. 1970-71.

Fertilizer Plow-Down Time	N lb/A					
	0	55	110	165	110[1/]	Ave.[2/]
	Dry Matter T/A					
Fall	4.00	4.89	5.82	5.29	5.70	5.14
Spring	3.30	5.13	5.64	6.31	5.73	5.22
Ave.[3/]	3.66	5.02	5.73	5.80	5.71	
	N lb/A					
Fall	66.2	96.9	122.2	119.2	121.0	105.1
Spring	42.2	94.1	130.4	168.0	138.6	114.6
Ave.[4/]	54.2	95.5	126.3	143.5	129.8	

1/ N from nitrate of soda this treatment only. N from urea all other plots.

2/ No significant difference between average fall and spring application.

3/ Least Significant Difference (5% level) = 0.84 T/D.M.

4/ Least Significant Difference (5% level) = 28.6 lb. N.

Table 3. Influence of Nitrogen Rate, Source and Time of Application on Corn Total Dry Matter Yields and Total Nitrogen Recovery at Worcester Vocational Center. 1970-71.

Fertilizer Plow-Down Time	N lb/A					
	0	55	110	165	110 [1/]	Ave. [2/]
	Dry Matter T/A					
Fall	3.30	3.78	3.57	4.60	3.56	3.76
Spring	2.50	3.71	4.18	4.35	4.13	3.77
Ave. [3/]	2.90	3.74	3.87	5.44	3.85	
	N lb/A					
Fall	74.6	93.2	91.1	126.1	84.7	93.9
Spring	44.0	86.7	117.2	116.3	112.7	95.4
Ave. [4/]	59.3	89.9	104.2	121.2	98.7	

1/ N from nitrate of soda this treatment only. N from urea all other plots.

2/ No significant difference between average fall and spring application.

3/ Least Significant Difference (5% level) = 0.77 T/A.

4/ Least Significant Difference (5% level) = 30.8 lb. N.

Table 4. Influence of Nitrogen Rate, Source and Time of Application on Corn Total Dry Matter Yields and Total Nitrogen Recovery at George Redman Farm, Kent County. 1970-71.

Fertilizer Plow-Down Time	N lb/A					
	0	55	110	165	110 [1/]	Ave. [2/]
	Dry Matter T/A					
Fall	3.32	4.31	4.52	6.11	4.50	4.55
Spring	3.14	5.46	5.60	5.27	5.10	4.91
Ave. [3/]	3.23	4.88	5.06	5.69	4.80	
	N lb/A					
Fall	49.7	74.1	95.3	161.9	94.5	95.1
Spring	50.1	104.3	130.6	144.8	115.0	109.0
Ave. [4/]	49.9	89.2	113.0	153.4	104.8	

1/ N from nitrate of soda this treatment only. N from urea all other plots.

2/ No significant difference between average fall and spring application.

3/ Least Significant Difference (5% level) = 0.59 T/A.

4/ Least Significant Difference (5% level) = 22.8 lb./A.

Soybean Yield and Nitrogen Fixation Rate After Sixteen Years of Continuous Corn Under Various Nitrogen Fertilization Practices

D. F. Bezdicek and E. Strickling
Department of Agronomy

Purpose and Objectives

Many researchers have shown the soybean yield is dependent upon good fertility practices conducted on a previous crop such as corn. Continuous corn plots (16 years) at different N fertilizer rates were planted to soybeans in 1970 and 1971 to determine the influence of rate of fertilizer N on soybean yield and N_2 fixation rate.

Procedure

Continuous corn was planted 16 continuous years on Beltsville silt loam prior to 1970 in plots at the Plant Research Farm near College Park, Maryland. Plots were replicated three times with the following treatments:

1. Nitrogen fertilizer rates: 0, 100, and 400 lbs N/acre as NH_4NO_3 broadcast in the spring to planting for 16 continuous years on corn and on soybeans.

2. Cover crop: cover and no cover established during each fall during the corn studies.

3. All plots in 1971 were split. One half of all plots received treatments as originally stated; the other half of the plots did not receive any N. Therefore, the influence of residual N can be compared with those plots receiving added N.

Soybeans (Kent variety) were planted in 1971 in four-row plots of 10 x 30 ft. Nitrogen fixation rate by the acetylene reduction method was determined from nodulated roots from 1.5 ft. of row. Yields were determined from two-25 ft. rows.

Results

Nodule parameters for July 7 and soybean yield are shown in Table 1. Nodule N_2 fixation rate and nodule mass were significantly decreased by addition of fertilizer N. Nodule fixation rate was also significantly reduced from fertilizer addition which suggests that as fertilizer N is added, the fixation efficiency at these nodules receiving high N rates, decreased. The influence of cover and the N split did not significantly influence nodule parameters.

Soybean yield was significantly influenced from the addition of 100 lbs N/A. Yield was reduced 4.8 bu/A when the 100 lb treatment is compared with the 400 lb treatment. This reduction was likely caused from the relatively high rates studied. When soybean yield is compared in the split N treatments, significant yield differences were obtained. The greatest yield was obtained where no N was added in 1971. A part of the yield decrease from added N was undoubtedly due to the toxic effects of added N at the high rate of 400 lbs N/A.

Summary

The effects on soybeans of continuous corn under 0, 100 and 400 lbs N/A was varied. Soybean yield was increased 4.7 bu/A from the addition of 100 lbs N/A. It cannot be immediately determined from these results if this yield increase was a result of N applied in 1971 or from N applied in the previous years. In the split N treatments, a significant increase in soybean yield was obtained if no N was applied in those plots previously receiving N. These results would suggest that soybeans may respond to N if N was applied in the previous years, but not in the same year. Residual soil N may be influencing soybean yield.

Table 1. Fertilization rate, N_2 fixation rate, nodule mass, fixation efficiency and yield for soybeans, 1971.

Factor studied	N_2 fixation rate[1/] ul ethylene/hr	Nodule mass[1/] g	Fixation[1/] efficiency ul ethylene/g nodule/hr	Yield bu/A
N rate: 0 lbs/A	35.5**	2.7	13.8**	42.9†
100 lbs/A	20.2	1.9	8.9	47.6
400 lbs/A	5.2	0.3	2.4	42.8
Cover	19.6	1.6	7.7	43.6
No cover	21.0	1.7	9.1	45.4
N split: no N	21.4	1.6	8.8	46.5*
N	19.2	1.7	8.0	42.4

1/ Based on 1.5 ft. of row. All data were taken on July 7, 1971.

†, *, ** Significantly different at the 10, 5, and 1% level, respectively, for each factor studied.

Adaptation of Johnsongrass

Gordon W. Burt
Department of Agronomy

Purpose and Objectives

Adaptation of insects is rapid and is known to be an important factor in controlling undesirable species. In contrast to many insect species, however, the rate and the importance of plant adaptation is largely unknown. In 1970 the FAO International Conference on Weed Control stressed the "value of weed surveys in assessing distribution and change of the weed flora".

The following studies were undertaken as a continuation of a program designed to determine the extent and the importance of variations with johnsongrass. These past studies have shown that in the green-house a selection from Mississippi flowered later, was more resistant to dalapon, produced more rhizomes and total weight, grew taller and had fewer stems than two selections from Maryland. Growth chamber studies, however, indicated that the relative rhizome production of the three selections was dependent on photoperiod. These growth chamber studies were not consistent with greenhouse results because the Mississippi selection did not have statistically fewer stems and greater height than the northern Maryland selections.

An experiment was, therefore, conducted with 12 selections taken from Ill, Md., and Miss., to determine if the plants used in past studies were representative of the area from which they were taken or if there was a wide degree of variation among johnsongrass plants within a given environmental or geographical location. Results of the first experiment indicated that some of the earlier differences could be attributed to the different growth stages of the selections at the time of harvest. A

second experiment was, therefore, conducted in a similar manner except that plants were harvested at two similar stages of growth.

Procedures

Twelve selections of johnsongrass were obtained from different areas of the eastern United States: three from Mississippi, one from Illinois, four from the Eastern Shore of Maryland, and four from northern Maryland in the vicinity of Hagerstown. The selections from Maryland were chosen from established infestations in corn or soybean fields. Other selections were given to the author by Dr. C. G. McWhorter, Stoneville, Mississippi.

The twelve selections were vegatatively propagated in the greenhouse for at least one year in vermiculite watered weekly with nutrient solution. Each experiment was initiated by placing a 3-5 node rhizome segment from the stock greenhouse plants into vermiculite in 15 cm diameter pots. All pots were watered liberally once a week with a nutrient solution. After emergence half the original number of pots were discarded while selecting for uniformity. The pots were then placed in a randomized block design with 5 replications.

Results

The weight of plant parts after 9 weeks of growth (Table 1) indicated that ecotypes of johnsongrass exist. The rhizome production of selections from Mississippi was less than all other selections in treated and non-treated plants. Shoot weight was, however, greater in the Mississippi selections than in most other selections (Table 1). Shoot weight was less in both treated and non-treated plants for the selections obtained from Hagerstown, Maryland than from any other area. Root weights were not significantly different in the non-treated plants. The Mississippi and Illinois selections treated with dalapon had more root growth than

other selections. Total dry weight of the Illinois and Mississippi selections was greater than for other selections.

The time required for floral initiation was correlated to the latitude in which the selections were originally growing. 96% of the non-treated plants from northern Maryland (latitude approximately 40°) had inflourescences 7 weeks after planting compared to 67% of plants from Illinois (latitude unknown, 37-42°), 46% from southern Maryland (latitude approximately 38°) and 33% from Mississippi (latitude unknown, 30-35°) (Table 1). Floral initiation was partially inhibited by dalapon 9 weeks after planting. The Mississippi and Illinois selections had a greater percentage of plants flowering than the selections from Maryland.

Harvest weight of johnsongrass at 9 and 16 weeks after planting indicated similar results to the first experiment and showed no major differences between the two different harvest dates (Table 2).

Summary

Johnsongrass was obtained from several different regions and asexually propagated in the greenhouse. Plant growth characteristics indicated that johnsongrass has rapidly adapted to more northern climates. Time required for floral initiation was closely correlated to the latitude in which the selections were originally growing. Other characteristics of growth were also correlated to the area from which the plants were growing although these characteristics were more variable than the time required for floral initiation.

Table 1. Mean Growth Characteristics of Johnsongrass obtained from Illinois (Ill.) Mississippi (Miss), northern Maryland (Md-N) and southeastern Maryland (Md-SE) not treated and treated with dalapon.[a]

	Not Treated				Dalapon Treated			
	Md-N	Md-SE	Miss.	Ill.	Md-N	Md-SE	Miss.	Ill.
Rhizome Dry weight[b] (g)	37b	35b	24a	44b	28b	26b	19a	30b
Shoot dry weight (g)	65b	58a	74c	80c	45b	33a	57b	59b
Root dry weight (g)	34a	37a	40a	44a	28a	25a	36b	39b
Total dry weight (g)	136a	130a	138a	168b	102b	83b	112b	127b
% flowering[c]	96	46	33	67	25	17	45	33

[a]Figures followed by the same letter are not significantly different at the 5% level according to the Student-Newman-Keul's test. Comparisons are only valid within either not treated or dalapon treated values.

[b]Plants grown in 15 cm diameter pots for 9 weeks from a rhizome segment in the greenhouse.

[c]Recorded 7 weeks after planting for non-treated plants and 9 weeks for dalapon treated plants.

Table 2. Mean Growth Characteristics of Johnsongrass obtained from Illinois (Ill.), Mississippi (Miss.), northern Maryland (Md-N) and southeastern Maryland (Md-SE) harvested at 9 and 16 weeks after planting.[a]

	9 weeks after planting				16 weeks after planting			
	Md-N	Md-SE	Miss.	Ill.	Md-N	Md-SE	Miss.	Ill.
Rhizome dry weight (g)	3.9a	2.9ab	2.4b	3.7ab	31a	25b	23b	26ab
Shoot dry weight (g)	19a	15b	17ab	16ab	45a	33b	42a	28b
Root dry weight (g)	6a	5a	5a	6a	15a	13a	16a	11a
Total dry weight (g)	28a	23b	24ab	26ab	91a	71b	81b	65b
% flowering[b]	96	41	4	50				

[a]Figures followed by the same letter are not significantly different at the 5% level according to the Student-Newman-Keul's Test. Comparison are only valid within either 9 or 16 weeks after harvest data.

[b]Recorded 9 weeks after planting.

A New Johnsongrass Control for Corn

Gordon W. Burt
Department of Agronomy

Purpose and Objectives

Evidence has accumulated which indicates that the thiocarbamate herbicides have a potential to control johnsongrass in corn. The principle evidence was obtained by the author using the triphenyltetrazolium chloride (TTC) assay (Burt, Gordon W. 1973. Weed Sci (in preparation)). Thiocarbamate effectiveness is also, however, suggested by the similarities between the known reaction of johnsongrass to the toluidine and thiocarbamate herbicides applied at their recommended rates.

The following experiment was, therefore, conducted to determine if three of the most toxic thiocarbamates to johnsongrass rhizomes (according to the TTC assay) are effective johnsongrass control agents under practical field conditions. A new post-directed treatment was also evaluated.

Procedures

A johnsongrass infestation was selected for the experimental area at the residence of Mr. Ned Harrison, Cordova, Maryland. This area was infested with johnsongrass for more than 10 years. During the last ten years the area was not used agriculturally but was periodically mowed and spread with poultry manure. The soil was rated high for magnesium, very high for phosphate and medium for potassium by the soil testing service of the University of Maryland. The dominant soil series was Sassafras & Galestown silt loams with

a pH of 5.6 and 2.5% organic matter.

This experiment was conducted to give maximum advantage to johnsongrass growth over corn production. This was done in order to give the herbicides under study the most difficult test possible. In this regard a freshly plowed field was lightly spring toothed before herbicide incorporation to a depth of 3 inches with a rototiller. Preemergence herbicides (Table 1) were applied at 30 gallons per acre and immediately incorporated. These herbicides were commercially formulated with a protectant (N, N-diallyl-2, 2-dichloroacetamide) to prevent corn injury. On May 17, 1972, Pioneer var. 3369 A was planted with 300 lb/A of a 5-10-10 fertilizer. Two weeks later several rows and areas within rows were hand seeded where the grain drill had missed on May 17. Corn was not cultivated throughout the season in order to again give maximum pressure on the herbicide treatment. The plots with the post-directed herbicide (Table 1) did, however, receive a cultivation at the time of the post-directed treatment. Post-directed treatments were applied on July 10, 1972 in 53 gallons per acre to a foot tall johnsongrass. The corn at this time was approximately 3 feet tall and was sprayed on the lower 2 feet.

Plots were replicated 4 times in a randomized block design. Visual ratings of johnsongrass control were made several times throughout the season. Johnsongrass was harvested by hand on September 8, 1972 from between the center two rows and the weight recorded. Corn harvest from the center two rows was on October 20, 1972. Stand was estimated at 12,000 plants per acre at this time.

Results

Thiocarbamate herbicides used in this study were found to have a significant effect on johnsongrass control as measured by visual ratings. (Table 1). The best treatment was EPTC at three times the normal rate (12 lb/A) which gave 86% johnsongrass control at the end of the season (Table 1). At two times the normal rate EPTC control of johnsongrass was 80% on 6/2/72. This control was equal to the control caused by equivalent rates of vernolate and 10% greater (not significant) than butylate. At the end of the season (7/28/72) however, EPTC at two times its normal rate was statistically greater than both vernolate and butylate. Butylate at normal rates (4 lb/A) was consistently the poorest treatment. This treatment decreased in effectiveness throughout the season until on 7/28/72 it was the only treatment whose visual rating was not significantly different from the controls. Butylate at two times its normal rate gave significant but unsatisfactory control (46%) at the last rating date. At three times its normal rate, butylate gave satisfactory control (70%) throughout the growing season. Johnsongrass control from vernolate at two and three times the normal rate was 20% greater (not significant) than for butylate at corresponding rates on 6/2/72. Almost two months later (7/28/72), however, vernolate control ratings were the same as for butylate at the same equivalent rates (Table 1). All post-directed treatments gave excellent control.

Conclusions from the johnsongrass and corn harvest (Table 2) are similar to those from visual estimates. Both corn yield and weight of johnsongrass indicate that three times normal rate of EPTC gave the best control of all thiocarbamate treatments. The post-directed treatments indicated that excellent johnsongrass control was obtained but not without severe corn injury.

It was concluded that control of johnsongrass can be accomplished in corn with thiocarbamate herbicides. The present study indicated that 8 lb/A EPTC is close to an optimum rate. Eight pounds of EPTC would cost approximately $18.00/A. Further work must be conducted to determine effectiveness with more tillage and under different environments.

Summary

A field experiment was conducted to determine if thiocarbamate herbicides are effective in controlling rhizometous johnsongrass in corn. All herbicides tested had a significant effect on johnsongrass. EPTC was the most effective. The data indicates that EPTC is an effective and practical means of controlling johnsongrass in corn.

Table 1. Control of Johnsongrass in Corn (Visual Rating)[a]

Rate of Application lb/A	Normal rate equivalent of thiocarbamate	Herbicide	6/2/72	6/9/72	6/26/72	7/19/72	7/28/72
----	------	Control	oc	oe	od	od	oc
4	1	butylate	47b	33d	28c	30c	20c
4 + 1/2	1	butylate + glyphosate	47b	33d	28c	80a	81a
4 + 1	1	butylate + glyphosate	47b	33d	28c	90a	90a
8	2	butylate	63ab	57c	42bc	40bc	46b
8 + 1/2	2	butylate + glyphosate	63ab	57c	42bc	90a	92a
8 + 1	2	butylate + glyphosate	63ab	57c	42bc	90a	90a
12	3	butylate	70ab	70abc	63ab	70ab	71a
6	2	vernolate	80ab	60bc	40bc	60ab	45b
9	3	vernolate	90a	90ab	75a	70ab	71a
8	2	EPTC	80ab	80abc	63ab	70ab	74a
12	3	EPTC	70ab	100a	85a	90a	86a

[a]Mean values as % of control. 0 = noncontrol, 100 = 100% control. Values not followed by the same letter in the same column are significantly different at the 5% level according to the student-Newman-Keuls' Test.

Table 2. Control of Johnsongrass in Corn (Harvest data) and corn injury (visual rating)[a]

Rate of Application					
Lb/A	Normal rate equivalent of thiocarbamate	Herbicide	Johnsongrass	Corn Yield[c]	% Corn Injury[d]
----	----	Control	24.3a	2.1a	----
4	1	butylate	22.9a	2.4a	0
4 + 1/2	1	butylate	7.6b	7.7a	40
4 + 1	1	butylate	4.6b	0a	100
8	2	butylate	15.3ab	19.7ab	0
8 + 1/2	2	butylate	3.9a	0a	50
8 + 1	2	butylate	4.6	0a	100
12	3	butylate	15.0ab	32.7bc	0
6	2	vernolate	15.9ab	14.7a	0
9	3	vernolate	12.1b	40.0cd	0
8	2	EPTC	9.3b	42.4cd	0
12	3	EPTC	5.6b	55.7d	0

[a] Values not followed by the same letter in the same column are significantly different at the 5% level according to the Student-Newman-Keul's test.

[b] Pounds per 30' X 30'' area, harvested on September 8, 1972.

[c] Harvested center 2 rows on October 20, 1972. Presented as 15 1/2% moisture, U. S. Grade No. 2.

[d] Visually rated on July 28, 1972. Only obvious herbicidal injury and not injury from weed competiton was rated.

Toxicity of Thiocarbamate Herbicides To Johnsongrass Rhizome Tissue

Gordon W. Burt
Department of Agronomy

Purpose and Objectives

Control of rhizometous johnsongrass has been recently accomplished through the use of herbicides previously considered ineffective (McWhorter. 1970. Weed Sci. Soc. Amer. Abstracts pg. 13). Effectiveness of the herbicides was obtained by application of higher than normal rates for a period of two or more years. These herbicides are in the toluidine class (e.g. trifluralin (Treflan)) and their use is restricted primarily to soybeans. Both the thiocarbamate and the toluidine herbicides are known to control johnsongrass from seed and have little or no effect on rhizomes when applied at a recommended rate. There is, therefore, a similarity between the reaction of johnsongrass to the toluidine and the thiocarbamate herbicides. The possibility exists, therefore, that the thiocarbamate herbicides could be used at higher rates to control rhizometous johnsongrass in an analagous manner to the toluidine herbicides. The significance of this possibility lies in the fact that the thiocarbamate herbicides (e.g. butylate (Sutan)) are used on corn. This would, therefore, make available johnsongrass control methods in the two most important field crops in Maryland (corn, soybeans) where johnsongrass is an important problem.

Two or more years of field evaluation would be required to determine if the thiocarbamate herbicides are effective in controlling rhizometous johnsongrass. Such an extensive outlay of time and material was not considered justified until some preliminary data were obtained indicating that the thiocarbamates are toxic to johnsongrass rhizomes. Field success could be anticipated only if johnsongrass rhizomes were found to be inherently

susceptible to the thiocarbamates. The present study was, therefore, conducted to determine if johnsongrass rhizomes are susceptible or resistant to several thiocarbamate herbicides. Triphenyltetrazolium chloride (TTC) assay was chosen as the technique used to obtain the desired information because of its simplicity.

Procedure

Johnsongrass was vegetatively propagated and grown in vermiculite in the greenhouse until rhizomes formed. Flats were watered biweekly with nutrient solution containing four times the concentrations as used in Table 1 ofWoodman (Woodman, R. M. 1939. Ann. Bot. Land. ns. 3:649-667). Nitrogen was supplied at 100 ppm as $NaNO_3$. The micro elements were supplied as in Hoagland and Arnon (Hoagland, D. R. and D. I. Arnon. 1950. Calif. Agr. Exp. Sta. Circ. 347:132).

For the initiation of each run, sufficient rhizome material was harvested from the flats and cleaned. The internodes were cross sectionally cut into one or more 2 to 3 mm thick disks to total approximately 100 mg of tissue. The weight of this tissue was recorded and the tissue was immediately placed into 120 X 10 mm test tubes containing 3 ml solution of the appropriate concentration of herbicide in addition to a KH_2PO_4-Na_2HPO_4 buffer at pH 6.5. The tissue remained in the solution for 24 hours at room temperature under constant agitation and then was transferred to 3 ml of a 0.6% solution of 2,3,5-triphenyl-2H-tetrazolium chloride in KH_2PO_4-Na_2HOP_4 buffer at pH 6.5. The tissue was incubated in this solution for 24 hours at 30 C, ground one minute in an Omnimixer with 10 ml 95% ethanol, filtered through a Whatman No. 1 filter paper, and the optical density (OD) at 530 mu was recorded. Each chemical was analyzed for at least six concentrations after preliminary results indicated

the approximate concentration range for each chemical. Each run for each chemical had five replications and was repeated three times, therefore, there was a total of 15 replications per chemical per concentration. Data were calculated on a percentage of the control per 100 mg tissue. Linear regression was performed on all the data. Differences between regressions were determined as in equation 9.18 (Steel & Torrie, 1960. McGraw-Hill Book Co.).

Results

All four thiocarbamate herbicides injured johnsongrass rhizome tissue as measured by the TTC assay (Figure 1). EPTC was most effective because a lower concentration caused complete death of tissue (0% of control) than for the other herbicides (Figure 1). In order of decreasing effectiveness the four herbicides were: EPTC, vernolate, butylate, and pebulate. The greater slope of EPTC (Figure 1) was also considered to indicate that this chemical was the most toxic of the four chemicals studied. The concentration which caused 50% toxicity was approximately 7×10^{-4}M for the four herbicides. This value compared favorably to values obtained for toluidine herbicides (Burt, G. W. 1972. Weed Sci. Abstract No. 163). These data, therefore, support the hypothesis that the thiocarbamate herbicides can be used to control johnsongrass in the field. Field studies were, therefore, initiated with the herbicides used in this study with the exception of pebulate which was found to be the least toxic to johnsongrass rhizomes (Figure 1).

Summary

The TTC assay has shown that the thiocarbamate herbicides are toxic to johnsongrass rhizomes. This study, therefore, has encouraged further work to determine if the thiocarbamate herbicides can be used as an effective johnsongrass control measure in corn.

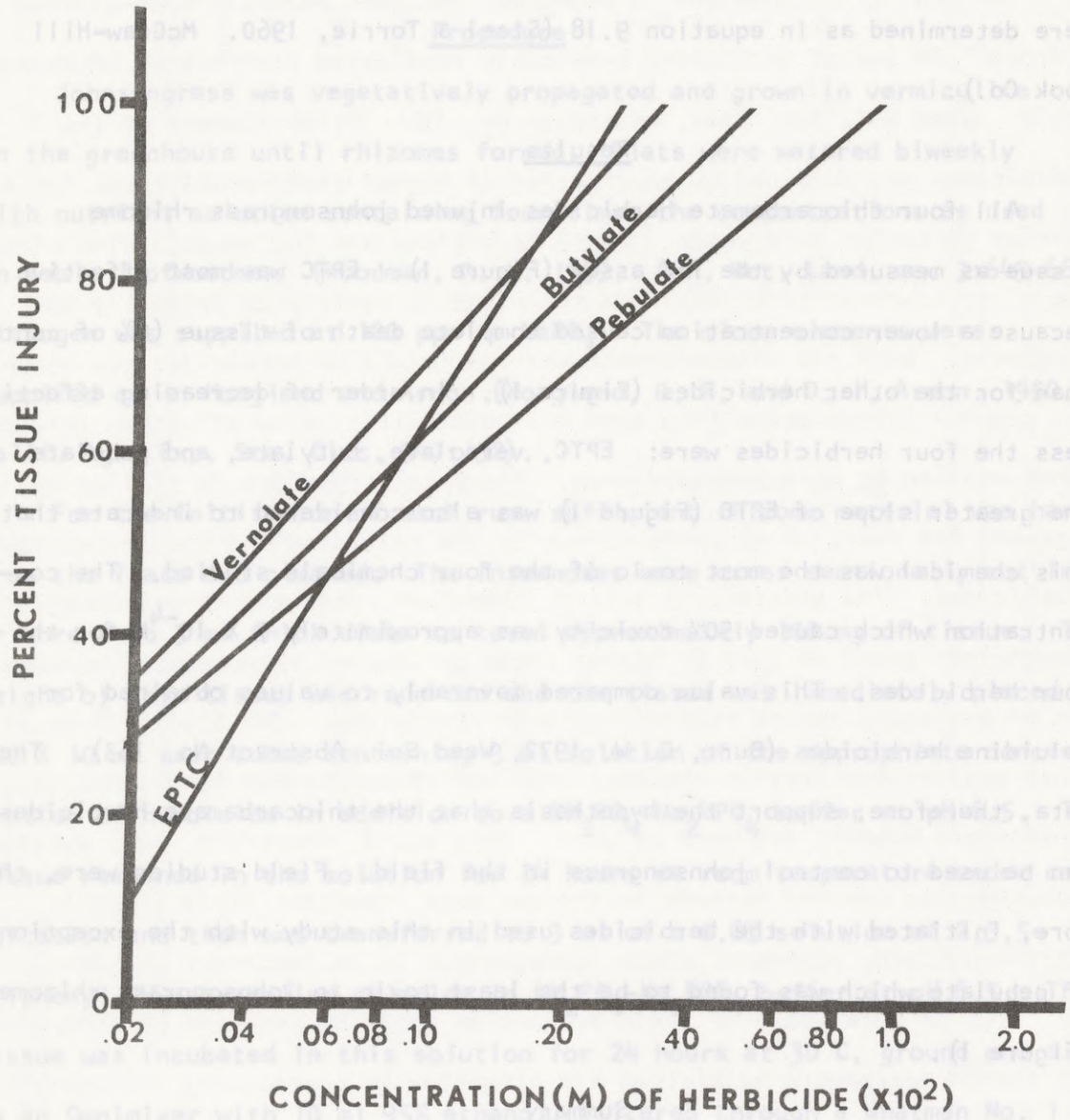


Figure 1 - Johnsongrass rhizome tissue injury after immersion in four toluidine herbicides for 24 hrs. Injury determined by the quantity of triphenyl tetrazolium chloride (TTC) reduced in 24 hr immediately following herbicide treatment. 100% injury = no TTC reduction, 0% injury = TTC reduction was the same as a control.

Volatility of Atrazine from Glass Surfaces

Gordon W. Burt
Department of Agronomy

Purpose and Objectives

Several studies have shown considerable atrazine loss through volatility. From nickle plated planchets Foy (1964. Weeds: 103-105) has reported a 95% loss in 15 hr at 60 C and no loss in 25 hr at 25 C. Kearney et al. (Weeds 12:83-87), however, reported 80% loss in 24 hr at 25 C and 95% loss at 35 C in 24 hr. There is very little understanding of the extent of atrazine volatility and the importance of different parameters of atrazine volatility. The following studies were conducted to determine the influence of several factors on the volatility of atrazine from glass surfaces.

Procedures

^{14}C-ring labeled atrazine was used as a tracer. 1 ul of the standard ^{14}C-atrazine solution contained 0.10 uc of ^{14}C and 1 ug of atrazine in (10 uc/mg) methanol. Atrazine trapped in a 13 X 2 cm diameter florisil column was assumed to be lost through volatilization. Air was drawn through this column at a predetermined rate by a suction pump. Air velocity through the column was periodically monitored by use of a Gilmont No. 12 flowmeter. All use of rubber or polyethylene material was avoided because atrazine was found to be adsorbed very rapidly to these materials. The quantity of atrazine volatilized was determined by eluting atrazine from the column with 100 ml chloroform and, after drying, counting the radioactivity in a Nuclear Chicago Unilux scintillation counter. Quenching was determined by the channel ratio

method. The scintillation fluid contained 4g/liter 2,5-diphenyloxazole (PPO) and 0.05g/liter p-bis- 2-(5-phenyloxazolyl) benzene (POPOP) in toluene. All data reported are means of at least 3 replications. The predetermined amount of atrazine was placed in 125 ml glass erlenmeyer flasks in 10 ml of chloroform. 1 ul of the standard ^{14}C-atrazine solution was added to the chloroform solution and thoroughly mixed. Immediately after chloroform evaporation under a hood, the flasks were placed in a growth chamber in the dark. The end of the column was placed within the flask approximately 5 mm above the surface of the atrazine. Radioactivity in the column after 48 hrs was determined as mentioned previously. Radioactivity remaining in the flask was determined by transferring several chloroform rinses to a scintillation vial with subsequent drying and counting as mentioned previously.

Results

Greater volatility of atrazine occurred at 40 C than at 20 C. Air velocity was found to have a considerable effect on volatility of atrazine at 20 C but only a slight effect at 40 C (Figure 1). The quantity of atrazine added to the flasks was found to affect atrazine volatility more than any other parameter tested in these studies (Figures 2 and 3). Approximately 70% of the atrazine was volatilized in 48 hr at 40 C at 2 liters per minute when 1 ug of atrazine was added with the tracer solution (Figure 2). This value is only 10% less than the comparable value (80%) when no cold atrazine was applied (Figure 1, 40 C, 2000 ml/min). Further additions of cold atrazine, however, greatly increased the amount of ^{14}C recovered from the flasks at the end of 48 hr (Figure 3). Although the amount of atrazine present was the most important factor affecting atrazine volatility, the

purity of the atrazine also had a significant affect at most concentrations used in this study. At all concentrations where statistical differences were evident, the 80% wettable powder (AAtrex) volatilized more than the technical pure atrazine. This could be a result of a more even spreading of the 80% wettable powder on the glass surface.

Summary

Atrazine volatility from glass surfaces was determined by passing air above the experimental material through florisill columns. Percent atrazine volatility was estimated by counting the ^{14}C-atrazine present in the column eluate and that which remained on the treated surface. Volatility from 125 ml glass erlenmeyer flasks was influenced by temperature, air velocity, purity of the atrazine and, most important, the amount of atrazine present. It was concluded that atrazine volatility could be a major factor under practical conditions.

Figure 1. Influence of temperature and air velocity on the volatility of ^{14}C-atrazine from a glass surface in 48 hours. Volatile ^{14}C-atrazine was trapped in a florisil column, eluted, and counted. Quantity of ^{14}C-atrazine was 0.1 μc with 1 μg of atrazine.

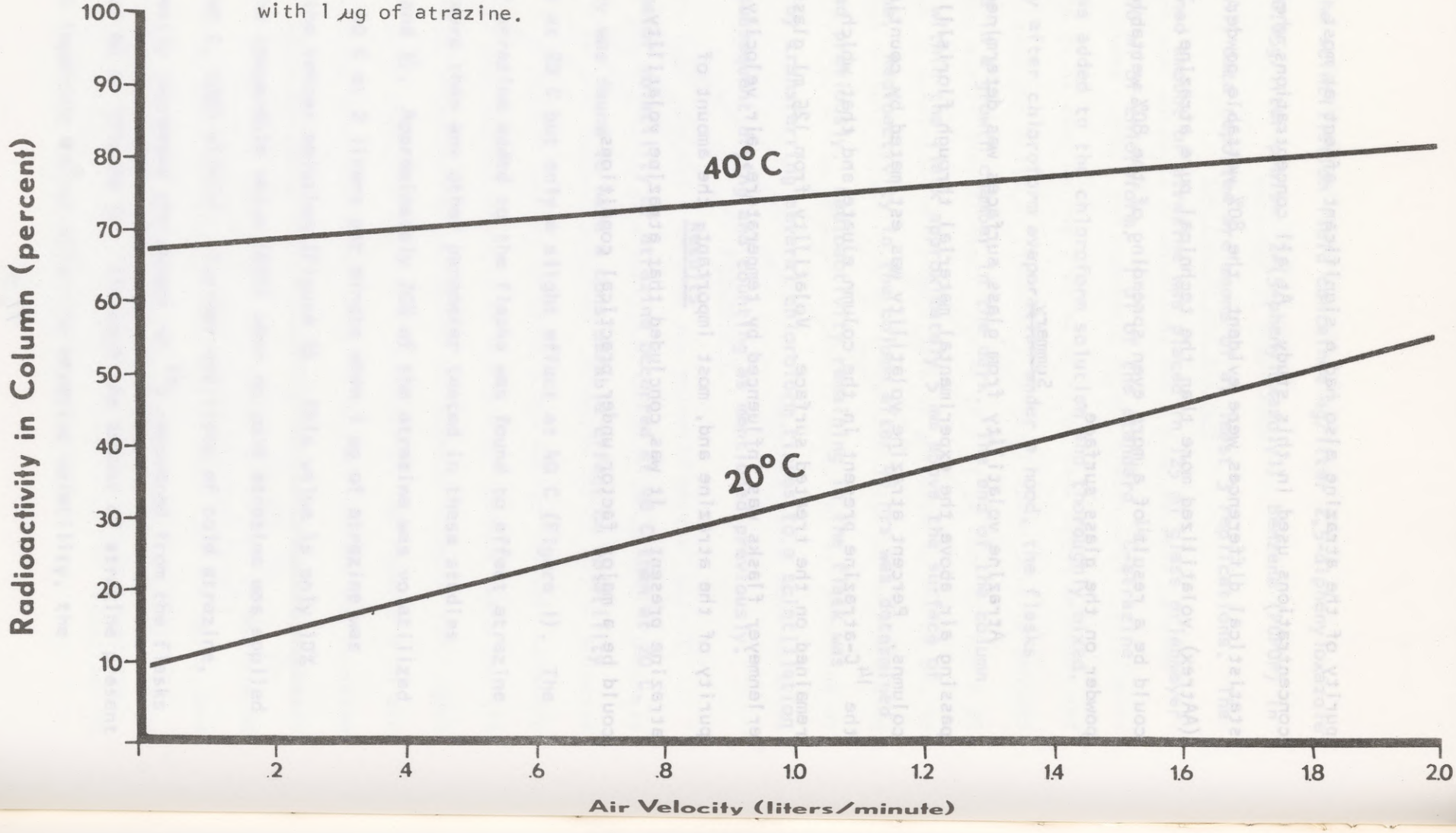


Figure 2. Influence of quantity and formulation of atrazine on the percentage of atrazine volatility in 48 hours at 40 C and with an air velocity of 2 liters per minute. Volatile ^{14}C-atrazine (0.1 μc) was trapped in a florisil column, eluted and counted. Tech. Pure = 97% pure. 80W = 80% wettable powder, commercial formulation (AAtrex).

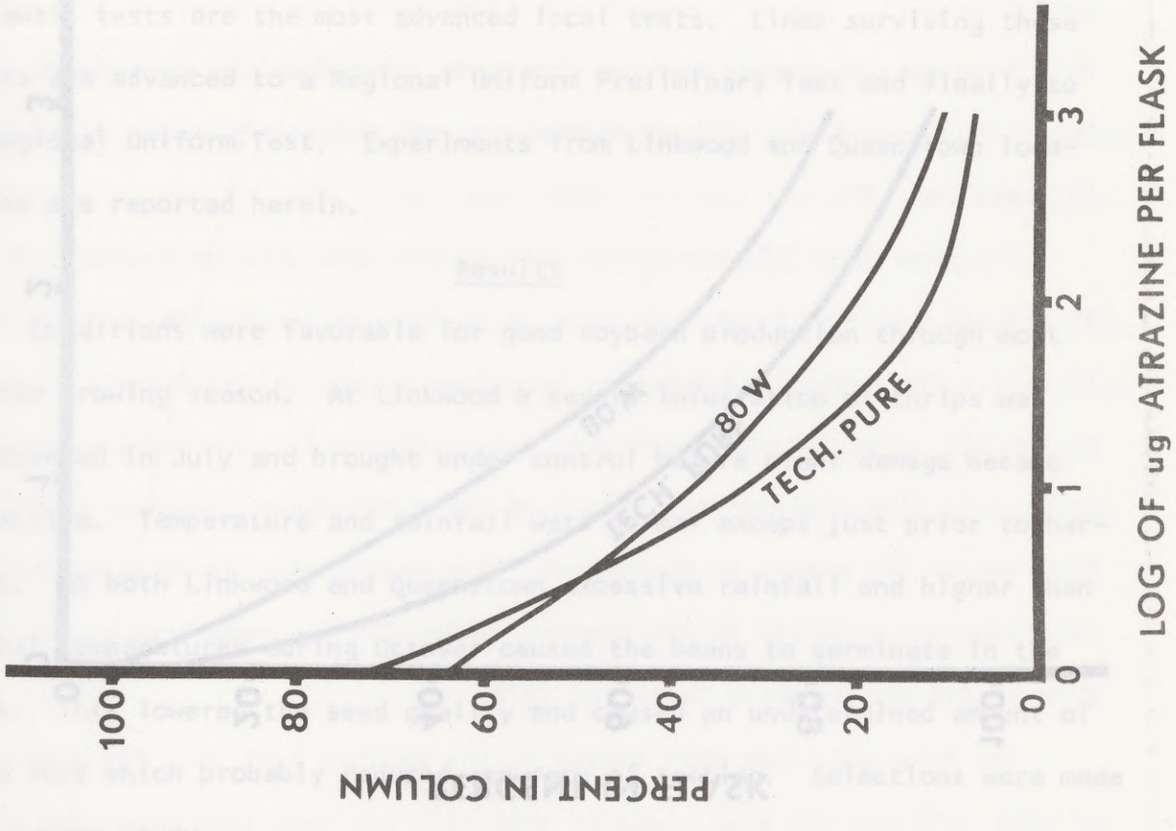
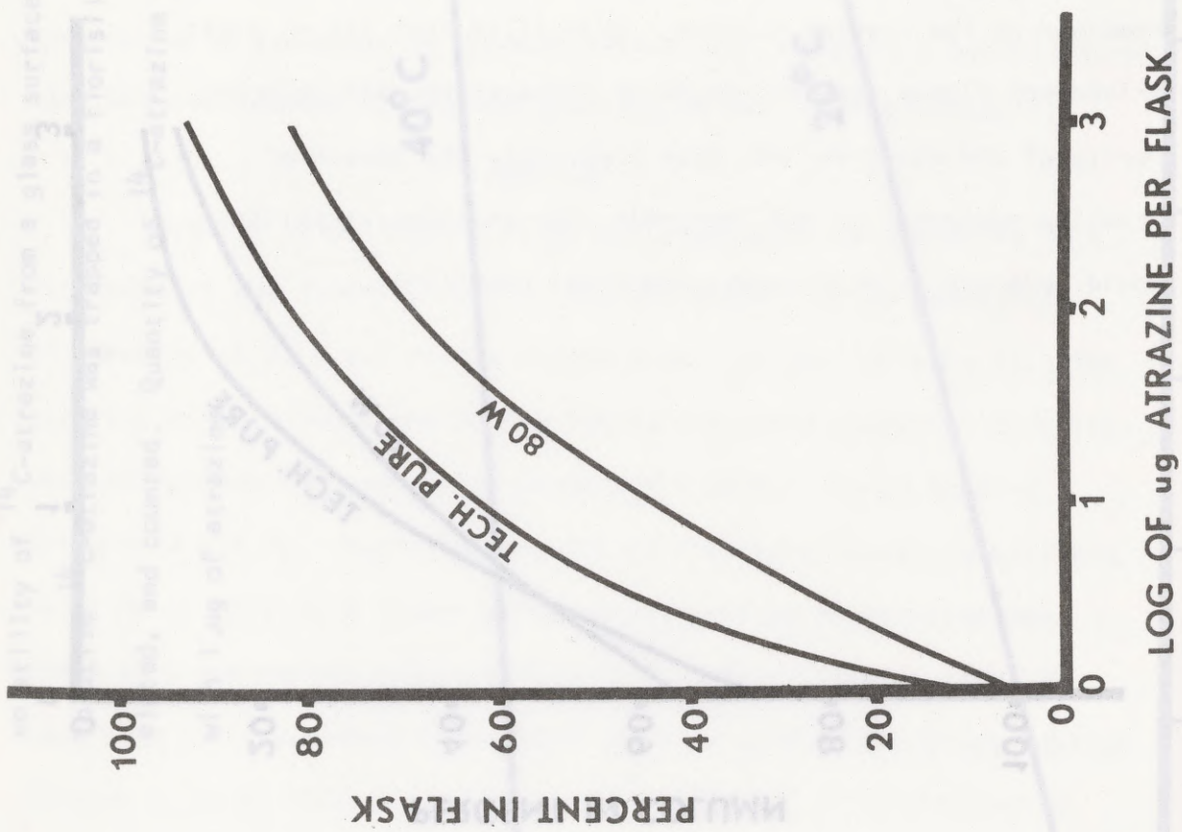


Figure 3. Influence of quantity and formulation of atrazine on the percentage of ^{14}C-atrazine (0.1 μc) remaining on a glass surface after 48 hours at 40C and within air velocity of 2 liters per minute. Tech. Pure = 97% pure. 80W = 80% wettable power, commercial formulation (AAtrex).



Breeding and Evaluating Full Season Soybean Genotypes

B. E. Caldwell and V. L. Miller
Plant Physiology Institute, U.S.D.A. and
Department of Agronomy

Purpose and Objectives

To develop soybean varieties, adapted to the Mid-Atlantic states, which are superior to those varieties presently being grown in this area.

Procedures

Breeding procedures used in this program were standard bulk and pedigree systems. Crosses were made and populations maintained in bulk until the F_3 or F_4 generation. Selections were made and evaluated in yield tests. Superior lines were then advanced for more extensive testing. The Mid-Atlantic tests are the most advanced local tests. Lines surviving these tests are advanced to a Regional Uniform Preliminary Test and finally to a Regional Uniform Test. Experiments from Linkwood and Queenstown locations are reported herein.

Results

Conditions were favorable for good soybean production through most of the growing season. At Linkwood a severe infestation of thrips was discovered in July and brought under control before plant damage became excessive. Temperature and rainfall were normal except just prior to harvest. At both Linkwood and Queenstown excessive rainfall and higher than normal temperatures during October caused the beans to germinate in the pods. This lowered the seed quality and caused an undetermined amount of seed loss which probably reduced accuracy of testing. Selections were made for future study.

In 1971 the USDA and the University of Maryland jointly released the new soybean variety "Wye". This line originated from diallel crosses made in 1951 and survived preliminary testing through 1971. In 1968 it was entered in the Mid-Atlantic and Uniform Preliminary Tests where it performed well. In 1969 it was advanced to the Uniform Group IV Test, retested in the Mid-Atlantic states in 1970, and finally reentered in the Uniform Group and Mid-Atlantic Tests IV in 1971 and released. Wye is especially well adapted to double cropping and narrow rows.

Only one Maryland line (Md66-1024) was entered in the 1971 Uniform Preliminary Test (Table 1). At Linkwood Md66-1024 yielded more than either of the check cultivars but its mean yield for 10 locations was 2.2 bushels less than Kent. The oil content was higher than the checks at Linkwood. This line matures 2 days earlier than Kent. Based on the data for the local area test Md66-1024 was advanced to the Mid-Atlantic and Uniform Group IV Tests for 1972.

The line Md66-1258 performed well in the 1970 Uniform Preliminary Test IV and was advanced to Uniform Test IV as well as the Mid-Atlantic Test IV in 1971. The mean yield for nine locations in the Uniform Test IV was equal to the best yielding check cultivar Cutler (Table 1). In the local testing areas this line yielded less than 2 of the 3 checks at Linkwood, but better than any of the checks at Queenstown. The mean yield for both Maryland locations was superior to the checks. Md66-1258 was reentered in the Uniform IV and Mid-Atlantic Tests for 1972.

Two Maryland lines were tested in the Uniform Test IV. The mean yield of Md66-1058 and the mean yield of Md66-1311 was less than Kent when six locations were considered (Table 1). However, when compared to the check in the Maryland tests both lines were superior. The most promising line

appears to be Md66-1311 which yielded 1.5 and 6.6 bushels more than Kent at Linkwood and Queenstown, respectively. Md66-1311 is 5 days later than Kent and was moved to the later maturing Mid-Atlantic V Test for 1972.

Mid-Atlantic Test IV included five Maryland lines (Table 2). None of these lines were superior to Cutler at Linkwood. At Queenstown Md65-1105, Md65-1109 and Md66-1258 outyielded the checks. When both location yields are averaged Md66-1109 is the only line superior to the checks.

Mid-Atlantic Test IVS contained 11 Maryland lines for evaluation (Table 2). Seven of these lines outyielded Cutler at Linkwood, but only one line was superior at Queenstown. The best yielding lines when averaged over both locations were Md62-3505, Md66-1311, and Md69-410. Of the 11 lines tested in 1971 six performed well enough to retest in 1972. Md69-410 was advanced to the Uniform Preliminary Test and Md62-3505, Md66-1057, Md66-1155, Md66-1311, Md66-1327 and Md64-410 are to be retested in the Mid-Atlantic program in 1972. Two lines Md66-1311 and Md69-410 were reclassified for maturity and entered in the later maturing Group V Tests.

Selections from a population of 300 homozygous lines conducted at Linkwood in 1971 are to be tested in 1972. The 30 top yielding lines are to be evaluated at Linkwood and Queenstown. Any that perform better than those cultivars normally grown in Maryland will be considered for entry into the Mid-Atlantic Tests for 1973.

Table 1. Performance of Maryland lines in Uniform Preliminary and Uniform Tests. 1971.

	Yield				Linkwood			
	Mean of 10 locations	Linkwood	Queenstown	Mean of Linkwood Queenstown	Seed Quality	Protein	Oil	Maturity[1/]
	Uniform Preliminary Test IV							
Kent	47.7	37.9	-	-	2	38.8	22.4	34
Clark 63	43.4	33.4	-	-	2	37.5	22.9	24
Cutler 71	46.4	36.4	-	-	3	38.9	23.0	24
Md66-1024	45.4	38.9	-	-	3	38.2	23.8	32
	Uniform Test IV Mean of 9 Regional locations							
Kent	43.5	35.1	51.9	43.5	2	40.5	21.8	31
Cutler	45.0	37.4	46.9	42.2	3	41.2	21.5	27
Cutler 71	44.6	35.9	47.4	41.6	3	40.4	21.7	28
Wye	43.5	27.1	48.6	37.8	3	40.4	22.7	32
Md66-1258	45.0	35.8	52.2	44.0	3	40.4	21.4	28
	Uniform Test IVS Mean of 6 Regional locations							
Kent	40.8	37.9	44.6	41.2	3	39.2	22.4	34
Md66-1058	40.9	38.0	48.6	43.3	2	38.4	24.0	33
Md66-1311	39.7	39.4	51.2*	45.3	2	39.2	23.8	39

[1/] Number of days after August 31.

* Strains yielding significantly more (odds 19:1 or greater) than Kent.

Table 2. Performance of Maryland lines in Mid-Atlantic Tests IV and IVS. 1971.

	Yield		Mean of Linkwood Queenstown	Linkwood			
	Linkwood	Queenstown		Seed Quality	Protein	Oil	Maturity[1/]
Mid-Atlantic Test IV							
Clark 63	35.5	29.6	32.6	2	38.3	23.3	25
Cutler	40.6	38.7	39.6	3	39.3	22.9	27
Wye	32.7	33.2	33.0	3	38.2	24.6	26
Md62-3303	35.9	32.9	34.4	3	38.9	24.1	26
Md65-3806	35.3	34.0	34.6	3	38.9	22.9	25
Md65-1105	37.7	40.8	39.2	2	37.4	23.6	29
Md65-1109	38.2	44.8	41.5	2	38.0	24.1	30
Md66-1258	37.2	39.4	38.3	3	38.9	22.9	27
Mid-Atlantic Test IVS							
Kent	31.9	40.2	36.0	3	40.6	22.6	30
Delmar	35.4	47.6	41.5	3	39.5	23.9	40
Md70-100	38.6	45.0	41.8	2	39.5	22.6	48
Md62-3505	38.8	50.4	44.6	3	39.0	24.9	39
-3514	32.5	40.4	36.4	4	40.7	22.9	34
-3514-4	32.2	38.0	35.1	3	40.8	23.1	29
-3514-10	33.2	46.4	39.8	4	40.4	22.5	32
Md66-1056	38.0	45.1	41.6	3	40.1	23.0	36
-1057	36.8	27.3	32.0	4	37.9	23.6	32
-1155	39.6	41.4	40.5	3	39.1	22.9	34
-1311	38.9	49.0	44.0	2	40.4	22.4	44
-1327	38.5	44.4	41.4	3	40.8	23.6	40
-1344	30.8	37.2	34.0	4	40.5	23.9	29
Md69-410	41.4	46.2	43.8	2	40.3	22.5	45

[1/] Number of days after August 31.

The Response of Field Crops to Fertility and Irrigation

N. A. Clark
Department of Agronomy

Purpose and Objectives

This study compares corn, barley, and soybeans under three fertility levels, and with overhead irrigation, sub-irrigation, and no irrigation. Sub-irrigation, with perforated plastic pipe, is a recent development, and it is possible that water use by the system might differ from that of overhead systems due to differences in evaporation and water movement into the subsoil. Objectives of the study were to compare irrigation systems and the efficiency of fertilizer use under the three irrigation regimes.

Procedures

The experiment was a split plot design with irrigation regimes as whole plots. Crops and fertility treatments were assigned at random as subplots within each whole plot. There were three replications. The crops were: corn grain (fallow), corn silage (fallow), corn silage - barley silage (double crop), soybeans - barley grain (double crop). Fertilizer treatments were: $\frac{1}{2}$ soil test, soil test, and double soil test recommendation. Overhead irrigation was by a Skinner sprinkler system and sub-irrigation was by means of a $\frac{1}{2}$-inch plastic pipe with a 0.03-inch hole at one-foot intervals along the pipe. The pipe was buried one foot deep, and the pipes were spaced every three feet the length of the whole plot. Pressure was maintained at three pounds by a tank with a leveling float at the head of each sub-irrigation plot.

Planting and harvest dates are shown in Table 1, and fertilizer treatments are in Table 3.

Results

Rainfall and irrigation are shown in Table 2 and yields in Table 4. Both overhead and sub-irrigation water was applied in April because natural rainfall was somewhat deficient. However, in May natural rainfall was extremely heavy and no additional water was needed. Three inches of water were applied to both the overhead and sub-irrigation plots in July following the 75% of normal rainfall which occurred in June. On August 15, a severe and devastating hailstorm occurred followed by periods of torrential rains. Total rainfall was over 12 inches. Crops were severely damaged - so much so that the soybeans had to be harvested as silage rather than beans as intended.

All crops except soybeans (Table 4) showed a response to the medium and high rates of fertility. The soybeans did not show a response to irrigation nor did the winter barley crops. The lack of response to irrigation by the winter crop might be expected. In the case of soybeans, the damage to the leaves and growing points by the hailstorm was so great that yield petentials could not be expressed. Response by the three corn crops to sub-irrigation was erratic. The reason for this was established during the summer growing season when careful examination of the sub-irrigated plots showed an irregular distribution of water. Further investigation revealed debris-plugged orfices in the underground pipe in some areas and longitudinal cracks in the pipe from which water seeped in other areas. Yields from the overhead-irrigated high fertility plots for the three corn crops were consistently higher than the other fertility or irrigation treatments.

Summary

Corn, barley, and soybeans were compared under three fertility levels and with overhead irrigation, sub-surface irrigation, and no irrigation. Rainfall was abundant or over-abundant during much of the growing season, making irriga-

tion unnecessary most of the time. A severe hailstorm on August 15 greatly damaged all crops. All crops except soybeans showed a response to medium and high levels of fertilizer. Soybeans did not show a response to irrigation nor did the winter barley crops. Response by corn to sub-irrigation was erratic. The three corn crops showed a consistent response in yield to high fertility and overhead irrigation.

Table 1. Planting and Harvest Schedules for 1971.

Crops	Planting Date	Harvest Date
Barley (silage) - Wong	11/12/70	6/03/71
Barley (grain) - Barsoy	11/06/70	7/01/71
Corn (grain) - DeKalb XL66	6/02/71	10/19,20/71
Corn (silage) - Pioneer 3369A	6/02/71	10/12,13/71
Soybeans - Calland	7/06/71	10/24/71
Corn Silage (double crop) - Pioneer 3373	6/10/71	9/16-20/71

Table 2. Rainfall and Irrigation for 1971.

Month	Rainfall (inches)	Irrigation Applied (inches)	
		Overhead	Sub-irrigation
April	2.59	1.25	1.25
May	8.44	-	-
June	3.07	-	0.90
July	6.27	3.00	3.00
August *	12.70	1.50	0.92
September	6.34	-	-

* Severe hailstorm on August 15; extensive crop damage.

Table 3. Fertilizer Application for 1971.

Crop	Fertility Level	Fertilizer Applied N	P_2O_5	K_2O	How Applied
		------- lbs/A --------			
Barley (silage)	Low	25.0	100.0	100.0	Plow down
	Medium	50.0	200.0	200.0	Plow down
	High	100.0	400.0	400.0	Plow down
Barley (grain)	Low	2.5	100.0	100.0	Plow down
		12.5	-	-	Top dress
	Medium	50.0	200.0	200.0	Plow down
		25.0	-	-	Top dress
	High	100.0	400.0	400.0	Plow down
		50.0	-	-	Top dress
Corn (grain)	Low	45.0	20.0	20.0	Plow down
		10.0	10.0	10.0	Planter
	Medium	90.0	40.0	40.0	Plow down
		20.0	20.0	20.0	Planter
	High	180.0	80.0	80.0	Plow down
		40.0	40.0	40.0	Planter
Corn (silage - fallow & double crop)	Low	66.0	30.0	30.0	Plow down
		3.7	7.5	11.2	Planter
	Medium	132.0	60.0	60.0	Plow down
		7.5	15.0	22.4	Planter
	High	264.0	120.0	120.0	Plow down
		15.0	30.0	45.0	Planter
Soybeans	Low	0.0	100.0	100.0	Broadcast
	Medium	0.0	200.0	200.0	Broadcast
	High	0.0	400.0	400.0	Broadcast

Table 4. Yields of Corn Grain, Corn Silage (fallow), Barley Silage, Corn Silage (double crop), Barley Grain, and Soybean Silage - 1971.

Irrigation Regime	Fertility Level	Corn Grain (fallow)	Corn Silage (fallow)	Barley Silage (double crop)	Corn Silage (double crop)	Barley Grain (double crop)	Soybean Silage
		Bu/A	T/A DM	T/A DM	T/A DM	Bu/A	Bu/A
No Irrigation	Low	71	5.9	1.7	5.3	41	1.6
	Medium	85	6.4	2.8	5.1	44	1.7
	High	93	6.8	4.5	6.2	53	1.8
Sub-Irrigation	Low	62	4.9	1.2	5.2	38	1.6
	Medium	81	7.3	2.4	5.7	47	1.9
	High	91	7.1	4.8	7.0	59	2.6
Overhead Irrigation	Low	61	6.8	1.8	5.4	44	1.7
	Medium	68	7.5	3.0	6.2	52	1.7
	High	102	9.6	5.4	7.6	58	1.8

Growth and Quality of Autumn-Saved Tall Fescue and Orchardgrass as Affected by Soil Temperature and Nitrogen Application

K. A. Archer and A. M. Decker
Department of Agronomy

Purpose and Objectives

During winter, pasture availability in most temperate areas of the U.S. is extremely low. This is due to: (1) the inability of pasture species to grow during winter, and (2) the absence of management practices aimed at producing pastures for grazing during the winter period.

Recent data from Iowa and Ohio have indicated that the use of autumn-saved tall fescue pastures may be valuable in substantially increasing availability of pasture during the cool seasons. Total dry matter production and quality of tall fescue during autumn and early winter was found to be superior to other temperate perennial species studied as autumn-saved pasture.

Although it is assumed that temperature is the major factor limiting the nutritive value of winter pastures, no data is available, especially from field studies, which separate the effects of temperature growth and quality aspects of winter pastures.

In this study, our objectives were to determine the yield and quality characteristics of tall fescue compared with orchardgrass for use as an autumn-saved pasture species in Maryland and to evaluate the effects of soil temperature and nitrogen fertilizer application on these species.

Procedures

Four soil temperature regimes (10 C, 21 C, 32 C, and check), two species (tall fescue and orchardgrass), and two rates of nitrogen fertilizer application (0 and 100 kg N/ha) were the treatments used in this field study. The experimental design was a split-plot with soil temperature as the main-plot effect.

The differential soil temperatures were obtained by utilizing field plots equipped with grids of pipes through which pre-heated or cooled water was circulated.

In mid-September, 1971, the pastures were established by sodding the two grasses onto the temperature plots. The nitrogen treatments were applied as a single dressing on September 25, 1971.

Samples were harvested from each plot on October 28, November 30, and December 30, 1971. The following data were obtained on all samples: total dry matter yield, yield and percentage of the dead and green fractions of the pasture, acid detergent fiber, lignin, neutral detergent fiber, and *in vitro* digestibility.

Results

The results are given in Tables 1 and 2.

Tall fescue produced more total, green and dead dry matter than orchardgrass at each harvest. Higher temperatures usually increased yields of both species, but by the final harvest tall fescue responded much more to increased temperature than did orchardgrass. Nitrogen application resulted in higher yields but had only small effects on the percentage of green material in the sward. Orchardgrass generally maintained a higher proportion of green leaves than tall fescue.

The *in vitro* digestibility of dry matter was not greatly affected by any treatment or by time of harvest. There was a slight increase due to high N, and orchardgrass maintained a slight advantage over tall fescue. The important factor here is that quality of the pastures remained high throughout the sampling period and this appeared to be due to the increased digestibility of the dead fraction with each harvest.

Summary and Conclusions

1. Although both species were similar in quality, the superior growth characteristics of tall fescue indicates it is the preferred species.
2. Nitrogen application significantly increased dry matter production but had little effect on quality.
3. While low soil temperatures appeared to be the major factor limiting growth and production of pasture, quality did not appear to be directly affected by temperature.
4. The relatively high digestibility of the dead fraction indicates that the quality of the pastures should continue to be adequate for grazing during winter.

Table 1. Effect of nitrogen fertilizer application (0 or 100 kg N/ha) and species (orchardgrass or tall fescue) on yield, % fiber, and digestibility of autumn-saved pastures.

Parameter	Nitrogen Application (kg N/ha)						Species					
	October 28		November 30		December 30		October 28		November 30		December 30	
	0	100	0	100	0	100	Orch	TF	Orch	TF	Orch	TF
Total Yield (kg DM/ha)	1751 a[1/]	2557 b	2275 a	3440 b	2361 a	3441 b	1746 a	2563 b	2349 a	3367 b	2217 a	3585 b
Green Yield (kg DM/ha)	1227 a	2180 b	1629 a	2682 b	1158 a	1753 b	1426 a	1982 b	1862 a	2448 b	1216 a	1695 b
Dead Yield (kg DM/ha)	524 a	377 b	630 a	759 a	1203 a	1688 b	320 a	581 b	487 a	903 b	1001 a	1890 b
% Green	70 a	85 b	72 a	78 b	50 a	52 a	79 a	76 b	78 a	72 b	54 a	48 b
% Neutral Detergent Fiber	53.8 a	49.7 b	50.4 a	48.9 b	53.9 a	54.1 a	50.4 a	53.1 b	47.4 a	51.9 b	51.1 a	56.8 b
% Acid Detergent Fiber	32.1 a	29.7 b	30.7 a	29.1 b	31.9 a	31.3 a	30.8 a	31.0 a	29.4 a	30.4 a	30.4 a	32.8 b
% Lignin	4.2 a	3.7 b	3.5 a	3.5 a	3.7 a	3.9 a	4.2 a	3.6 b	3.7 a	3.4 b	4.0 a	3.6 b
% *in vitro* Digestibility	80 a	85 b	78 a	80 a	81 a	82 a	83 a	82 a	80 a	77 b	82 a	80 a
% *in vitro* Digestibility of the green fraction	89 a	89 a	86 a	84 b	87 a	85 b	89 a	89 a	86 a	84 b	86 a	86 a
% *in vitro* Digestibility of the dead fraction	58 a	64 b	67 a	72 b	73 a	77 b	62 a	59 b	70 a	68 b	77 a	73 b

1/ Letters only indicate comparisons between each pair of means, i.e. within each harvest date and each treatment. The 5% level of significance was used to indicate differences.

Table 2. Effect of soil temperature (check, 10, 21, and 32 C) on yield, % fiber, and digestibility of autumn-saved pasture.

	Harvest Dates											
	October 28				November 30				December 30			
Parameter	Check	10 C	21 C	32 C	Check	10 C	21 C	32 C	Check	10 C	21 C	32 C
Total Yield (kg DM/ha)	2224 a[1/]	1920 a	2229 a	2244 a	2847 b	2392 a	3127 b	3066 b	2580 b	2362 a	3368 c	3294 c
Green Yield (kg DM/ha)	1801 a	1463 a	1817 a	1735 a	2165 b	1769 a	2406 b	2281 b	1348 b	1391 b	2033 c	1052 a
Dead Yield (kg DM/ha)	423 a	457 a	412 a	509 a	682 ab	592 a	721 b	784 b	1233 b	971 a	1336 b	2242 c
% Green	79 a	74 a	81 a	76 a	74 a	73 a	77 a	75 a	52 b	59 c	62 c	33 a
% Neutral Detergent Fiber	51.4 a	50.9 a	51.8 a	52.9 a	48.3 a	48.8 a	49.7 a	51.8 a	53.1 a	51.1 a	53.1 a	58.6 a
% Acid Detergent Fiber	30.7 a	30.0 a	31.2 a	31.6 a	29.1 a	29.4 a	30.2 a	30.9 a	31.5 a	30.1 a	31.3 a	33.6 a
% Lignin	3.9 a	3.8 a	3.9 a	4.2 a	3.4 a	3.5 a	3.6 a	3.6 a	3.6 a	3.4 a	3.7 a	4.4 b
% *in vitro* Digestibility	84 a	82 a	83 a	81 a	80 a	79 a	80 a	77 a	82 a	82 a	83 a	78 a
% *in vitro* Digestibility of green component	89 b	89 b	90 c	88 a	85 a	86 a	85 a	83 a	87 a	87 a	86 a	85 a
% *in vitro* Digestibility of dead component	60 a	59 a	62 a	63 a	72 b	67 a	69 b	70 b	76 a	73 a	76 a	75 a

1/ Letters indicate domparisons between the four temperature levels within each harvest date. The 5% significance was used to indicate differences.

Harvest Management of Crownvetch-Tall Fescue Mixtures

A. M. Decker
Department of Agronomy

Purpose and Objectives

Crownvetch has long been recognized as an excellent species for ground cover and bank stabilization. Because of its wide adaptibility to soil and climatic conditions, considerable interest has been generated in recent years in utilizing this species as a forage in the livestock industry.

Early work at Maryland and other states suggests that crownvetch could best be utilized as a forage when grown with a grass. With this in mind, stands of crownvetch and Ky-31 tall fescue were established. The objectives of the study were to measure total forage production and seasonal destribution of that forage as influenced by harvest frequency and stubble height. A third objective was to study the effects of harvest management on persistence of crownvetch.

Procedures

Penngift and Chemung crownvetch were seeded at the Plant Research Farm in randomly selected plots in each replication. Ky-31 tall fescue was uniformly seeded in all plots and borders. The area was uniformly harvested during 1969 to establish a uniform mixture of grass and legume. Harvest treatments were started in the spring of 1970 and continued through 1971. The design of experiment was a split plot with four replications. Crownvetch varieties were whole plots, harvest frequency (3, 4, 5 cuts) were sub-plots, and stubble height (1.5, 2.5, 3.5 inches) were sub-sub-plots.

Data were collected on total forage yields, seasonal distribution of that forage, and persistence of the crownvetch varieties.

Results

Forage yields were considerably different than in 1970 when drought prevented all of the scheduled harvests being made. Moisture distribution was much better in 1971, plus the entire area was uniformly irrigated twice when drought began to limit growth.

Yields for 1971, given in Table 1, show that increasing the number of harvests from four to five decreased yields. The decrease was greater with Penngift, which had a good stand of crownvetch, than with Chemung, where the stand of crownvetch was poor. Increasing the stubble height from 2.5 to 3.5 inches resulted in substantial reduction in yield. This also was more pronounced with Penngift where there was a higher percentage of legume present. There was little difference in yields between 1.5 and 2.5 inch stubble. However, the lower stubble height did reduce the stand of both crownvetch and tall fescue. So, in the long run, this treatment would be detrimental. Stubble height had a greater effect on yield where harvested three and four times than where five harvests were made. In this study, Penngift crownvetch was much more persistent than Chemung under all management treatments.

Summary

1. Penngift was more persistent than Chemung when grown with tall fescue.
2. Harvesting crownvetch-tall fescue mixtures at a 2.5 inch stubble height was better than harvesting at either higher or lower levels.
3. Harvesting more than four times during the growing season lowered forage yields.

TABLE 1. Dry matter yields of crownvetch and Ky-31 tall fescue mixtures as affected by harvest frequency and stubble height in 1971.

Treatments		Varieties		
Harvests (No.)	Stubble Height (in.)	Penngift (T/A)	Chemung (T/A)	Average (T/A)
5	1.5	3.37	2.28	2.82
	2.5	3.32	2.51	2.92
	3.5	3.10	2.31	2.70
	Av.	3.23	2.36	2.80
4	1.5	4.62	3.84	4.23
	2.5	4.52	3.47	4.00
	3.5	3.86	3.36	3.61
	Av.	4.33	3.55	3.94
3	1.5	4.41	3.68	4.04
	2.5	4.64	4.19	4.42
	3.5	2.94	3.80	3.37
	Av.	3.99	3.89	3.94
Averages	1.5	4.13	3.27	4.70
	2.5	4.13	3.39	3.76
	3.5	3.30	3.16	3.23
	Av.	3.85	3.27	

Midland Bermudagrass Flaming Studies

A. M. Decker and W. L. Harris
Departments of Agronomy and
Agricultural Engineering

Purpose and Objectives

Winter annual weeds are usually a problem with early harvests of Midland bermudagrass. When infestations are severe, growth initiation of the bermuda is retarded, forage quality is reduced, and weeds rob the crop of early spring moisture. These weeds can be reduced by fall sod-seeded cereals. In addition to controlling these weeds, seasonal forage yields are increased with the sod-seeded cereals (Maryland Bulletin 484, 1969).

Research with Coastal bermuda has shown that winter annual weeds can also be reduced by the burning of dormant stubble. These studies showed increased forage yields and more effecient nitrogen utilization when the source was urea.

The objectives of this research were to test the effects of controlled flaming on (A) winter annual weeds in Midland bermudagrass stands, (B) forage yields, (C) forage quality, as measured by percent protein, and (D) efficiency of nitrogen fertilization applied as NH_4NO_3 or urea.

Procedures

Two experiments at the Tobacco Research Farm were continued for the second year on a 5-year-old Midland stand growing on a Monmouth loamy fine sand with a pH of 6.2 and a medium to high level of P and K. The area was uniformly fertilized with 645 lbs/A of a 0-15-30 fertilizer each year.

Experiment 1:

The field plot design was a randomized split plot with six replications. The whole plots were 20 by 25 feet and consisted of sod-seeding, early flame, late flame, check. The sub-plots were nitrogen fertilizer rates of 200, 400,

and 800 lbs N/A in four equal split applications. The source of nitrogen was NH_4NO_3.

Cereal rye was seeded following the last harvest on September 18, 1970. The early flaming was done on April 15, 1970, when the bermuda was still dormant, and the late flaming on April 26, just as green shoots started to appear on the bermuda.

The sod-seeded rye was harvested on April 15. All treatments were harvested on May 28, June 23, July 26, August 26, and October 7. Nitrogen was applied April 27, May 28, June 28, and July 27. Representative samples (approx. 2 Kg) were collected from each plot and taken to the laboratory for botanical composition determination. Samples were then dried, ground, and used for nitrogen determinations. It was necessary to make separations only on the May and June harvests; the April harvest of the sod-seeded treatments and other harvests were essentially weed-free. Yields are reported in tons of dry matter per acre.

Experiment 2:

The field plot design was a randomized split plot with five replications. Whole plots were flamed vs. unflamed. Six sub-plots (200, 400, and 800 lbs N/A applied as NH_4NO_3 and urea) were completely randomized within each whole plot. The nitrogen fertilizer was weighed for each sub-plot and spread by hand to assure equal and uniform nitrogen applications.

The first nitrogen applicatinn was made April 30 with the remainder being applied in equal amounts after each of the next three harvests (June 1, June 28, and July 27). Harvest procedures were the same as in Experiment 1. The final harvest for both studies was made on October 7.

Results

Because of space limitation, only part of the data will be presented and discussed.

The major weed problem in bermuda occurs at the first spring harvest. Dry matter yields for this harvest and for the season are presented in Table 1. Flaming did not significantly alter Midland production at the first harvest, but the amount of weeds harvested was significantly higher where no flaming was done, with the late flaming (just as the Midland shoots started to grow) having the best weed control. There was a carry-over effect in weed control from flaming. These differences were marked early in the spring before the 1971 flaming treatments were applied. The amount of weeds present decreased with increased nitrogen rates. The sod-seeded crop also decreased the amount of weeds present. Fewest weeds were present in the high nitrogen plots and on those with sod-seeded rye. Late flaming, which gave best weed control, gave higher Midland yields than all other treatments. However, with rye added, the sod-seeded treatments gave the highest weed-free forage yields. Nitrogen increased yields significantly, with a high of 9.02 (10.3 ton/A H.E.).

In Experiment 2 (Table 2), late flaming again reduced the amount of weeds present in the first harvest. Source of nitrogen did not affect the percent of weeds present, but the rate of nitrogen did, as in Experiment 1, decrease the percent weeds present and increase total forage production. Ammonium nitrate produced significantly more weed-free forage, as well as total forage, than urea nitrogen fertilizer. This was not true for the 1970 growing season but has been reported by other researchers. Ammonium nitrate was superior to urea whether flamed or unflamed. Urea was inferior at all nitrogen rates.

Data on percent nitrogen in the tissue and nitrogen recovery are not presented, but the data were similar to those reported in 1970, except that recovery was higher with ammonium nitrate because of the higher yields obtained from this source of nitrogen fertilizer.

Summary

1. Flaming controlled winter annual weeds in Midland bermudagrass.
2. Flaming gave some residual weed control one year after flaming. Reduction in seed production of these annual weeds appears to be the reason.
3. Sod-seeding was superior to flaming in terms of weed control and total forage production.
4. Flaming increased forage yields and improved forage quality when done just as bermuda started to grow.
5. Flaming did not appear to improve efficiency of nitrogen utilization.
6. Ammonium nitrate was a more efficient source of nitrogen fertilizer than urea.

Table 1. First harvest and total dry matter yields as affected by flaming, sod-seeding, and nitrogen fertilization. (Experiment 1)

Treatment	Pounds N/A	1st Harvest (5-28-71) 2/ Midland plus Rye	1st Harvest (5-28-71) 2/ Midland plus Rye & Weeds	Total Yield 1971 3/ Midland plus Rye	Total Yield 1971 3/ Midland plus Rye & Weeds
Check	200	.21 cd 1/	.96 cd	4.79 gh	5.58 f
	400	.20 cd	.97 c	6.56 de	7.39 cd
	800	.22 cd	.79 ef	7.14 c	7.71 bc
	Av.	.21 B	.91 B	6.17 C	6.89 B
Early Flame	200	.20 cd	.67 f	4.58 h	5.18 g
	400	.25 cd	.83 de	6.51 e	7.11 d
	800	.26 c	.77 ef	7.31 bc	7.94 b
	Av.	.25 B	.76 C	6.18 C	6.75 B
Late Flame	200	.17 d	.27 g	5.17 g	5.48 fg
	400	.18 d	.29 g	7.02 cd	7.16 d
	800	.17 d	.26 g	7.78 b	7.86 b
	Av.	.17 B	.27 D	6.66 B	6.81 B
Sod Seeded	200	1.00 b	1.19 b	5.80 f	6.06 e
	400	1.23 a	1.38 a	7.69 b	7.88 b
	800	1.25 a	1.31 ab	8.96 a	9.02 a
	Av.	1.16 A	1.30 A	7.48 A	7.65 A
Average	200	.39 Y	.77 Y	5.08 Z	5.56 Z
	400	.47 X	.78 Y	6.95 Y	7.39 Y
	800	.49 X	.87 X	7.80 X	8.13 X

1/ Values within each column followed by the same letter are from the same statistical population at 5% level of significance. (A B C = treatments; X Y Z = nitrogen; a - g = T x N)

2/ First harvest for all but sod-seeded treatments, where it is second.

3/ Six harvests for sod-seeded treatments and five for all others.

Table 2. First harvest and total dry matter yields as affected by flaming, nitrogen source, and nitrogen rates. (Experiment 2)

Flame	Nitrogen Source	Nitrogen lbs/A		1st Harvest (6-1-71) Midland	1st Harvest (6-1-71) Midland plus Weeds	Total Yield 1971 Midland	Total Yield 1971 Midland plus Weeds
Yes	NH_4NO_3	200	1	.09 d[1/]	.19 f	4.37 e	4.34 f
		400	2	.22 bcd	.33 de	6.01 c	6.14 de
		800	3	.29 a	.46 d	7.37 a	7.54 ab
		Av.		.20 AB	.33 B	5.92 A	6.01 B
	Urea	200	4	.07 d	.18 f	3.46 f	3.67 g
		400	5	.19 bc	.32 e	5.33 d	5.53 e
		800	6	.29 a	.36 de	6.72 ab	6.81 c
		Av.		.18 B	.29 B	5.17 B	5.34 C
No	NH_4NO_3	200	7	.19 bc	.80 bc	4.22 e	4.87 f
		400	8	.25 ab	.93 ab	6.01 c	6.71 cd
		800	9	.22 bcd	1.05 a	7.25 a	8.08 a
		Av.		.22 A	.92 A	5.83 A	6.55 A
	Urea	200	10	.17 c	.72 c	3.82 ef	4.41 f
		400	11	.25 ab	1.00 a	5.17 d	5.95 e
		800	12	.28 a	.98 a	6.41 bc	7.13 bc
		Av.		.23 A	.90 A	5.13 B	5.83 B
Averages:							
Yes				.19 F	.31 G	5.54 F	5.67 F
No				.22 F	.91 F	5.48 F	6.19 F
	NH_4NO_3			.21 S	.63 S	5.87 S	6.28 S
	Urea			.21 S	.60 S	5.15 T	5.58 T
		200		.13 Z	.47 Z	3.96 Z	4.32 Z
		400		.23 Y	.64 Y	5.63 Y	6.08 Y
		800		.27 X	.71 X	6.94 X	7.39 X

1/ Values within each column followed by the same letter are from the same statistical population at the 5% level of significance. (F G = flame; S T = source; X Y Z = N rates; A B C = flame x source; a - f = F x S x R)

Responses of Alfalfa to Soil Temperature and Moisture Levels

A. M. Decker and J. M. Walker
Department of Agronomy and U.S.D.A.

Purpose and Objectives

Alfalfa grown in Maryland frequently shows boron deficiencies unless boron has been applied. These boron deficiency symptoms usually show up in mid to late summer when soil temperatures are high and when there is a shortage of soil moisture. One objective of this study was to see if the effects of soil temperature and soil moisture could be separated. A second objective was to measure growth responses of alfalfa as influenced by soil temperature and moisture.

Procedure

Spaced alfalfa plants were grown in the field at soil temperatures of 15 C, 21 C, ambient, and 32 C. Each soil temperature was maintained at low and high soil moisture. A clear plastic cover was placed over the experimental area to keep rain off and maintain dry conditions. The wet plots were irrigated as needed. Soil tensiometers were used to determine irrigation needs. A 5 cm (2 in.) straw mulch was placed on all plots to help maintain uniform soil temperature.

Results

The percent dry matter at harvest was not markedly affected by either soil temperature or soil moisture. However, most other determinations made were affected by the factors as shown in Table 1. Yields were low at 15 C regardless of soil moisture, while at higher soil temperatures low soil moisture decreased yields, particularly at 32 C. Leaf-stem ratios were highest at 15 C and lowest at 32 C. Low soil moisture decreased the ratio only at ambient and 32 C. All plants survived at 15 and 21 C, while nearly 30% were lost at 32 C.

Leaves were higher than other parts of the plant in N, P, Ca, and Mg, while there was little difference in the concentration of K. Soil temperature had little effect on N% in either stems or leaves. An increase in soil temperature generally increased the percentage of P and K but decreased the percentage of Ca. Temperature had little effect on Mg. Soil moisture had little effect on N% of stems or leaves. The percentage of P and K was generally lower with low moisture, while the reverse was true for Ca and Mg. Leaf deterioration and diseases increased with increased soil temperature and low soil moisture.

Summary

1. Percent dry matter at harvest was not affected by soil moisture or soil temperature.
2. Yields were highest at ambient followed by decreasing yields at 21, 32, and 15 C.
3. Leaf-stem ratios were highest at 15 C and lowest at 32 C.
4. Low soil moisture decreased leaf-stem ratio only at ambient and 32 C.
5. Leaves were higher in mineral concentration than the stems.
6. An increase in soil temperature generally increased P and K concentration but decreased Ca concentration, while N and Mg were little affected by temperature.
7. P and K percentages were generally lower with low soil moisture, while the reverse was true for Ca and Mg.
8. Leaf diseases increased with an increase in soil temperature and were greater at low soil moisture.
9. Boron deficiencies did not appear on any treatment, and samples have not yet been analyzed for that element.

Table 1. Dry matter yields, leaf-stem ratios, mineral concentration, and plant survival of alfalfa grown in the field at four soil temperatures and two soil moisture levels.

		15 C			21 C			Ambient			32 C		
		High*	Low*	Av.	High	Low	Av.	High	Low	Av.	High	Low	Av.
Grams per Plot		47	50	48	65	64	64	82	54	68	80	44	62
Leaf Stem Ratio		1.3	1.4	1.4	1.1	1.2	1.2	1.4	1.1	1.2	1.3	0.9	1.1
Mineral Concentration:													
Stems (%)	N	2.00	1.90	1.90	2.20	2.30	2.20	2.00	2.00	2.00	1.80	2.10	1.90
	P	.20	.20	.20	.28	.28	.28	.33	.23	.25	.31	.30	.31
	K	2.50	2.50	2.50	2.70	2.70	2.70	2.60	2.00	2.40	3.60	2.60	3.10
	Ca	1.12	1.17	1.14	.88	.89	.89	.84	.73	.80	.52	.64	.58
	Mg	.26	.37	.31	.23	.22	.22	.19	.22	.21	.29	.32	.30
Leaves (%)	N	3.80	3.80	3.80	4.20	4.10	4.10	4.00	4.00	4.00	3.90	4.20	4.00
	P	.28	.25	.26	.33	.32	.33	.34	.28	.31	.32	.33	.33
	K	2.60	2.30	2.40	2.80	2.70	2.70	2.70	2.10	2.40	3.40	2.60	3.00
	Ca	2.33	2.91	2.62	2.22	2.19	2.20	1.94	2.03	1.99	1.49	1.49	1.49
	Mg	.38	.48	.43	.40	.40	.40	.34	.41	.39	.32	.39	.36
Plant Survival (%)		100	100	100	100	100	100	100	96	98	100	46	73

* High and low soil moisture levels.

Responses of Corn to Controlled Field Soil Temperatures and Fertilizer Rates

A. M. Decker and J. M. Walker
Department of Agronomy and U.S.D.A.

Purpose and Objectives

Temperature exerts a major influence on plant growth and crop production, but the degree to which soil temperature per se controls these responses is not fully understood. The high correlation between air and soil temperatures contributes to this.

Most studies concerned with effects of soil temperature have been conducted either in the greenhouse or growth chamber where environmental factors are controlled. While this has provided valuable information, such conditions are "artificial" and results are difficult to translate to actual field situations.

The objectives of this study were to measure responses of a short season corn grown in the field at three fertility levels and four soil temperatures, and to determine if soil temperature growth responses obtained in the growth chamber could be duplicated in the field.

Procedures

Funk 17-A corn was grown in the field at soil temperatures of 16 C, 21 C, ambient (ck), and 32 C (50, 70 and 90 F) at fertilizer application rates of 224-0-0, 224-49-186, and 224-99-372 kg/ha of N-P-K (200-0-0, 200-44-166, and 200-88-332 lbs/A). Plants at a uniform 3-leaf stage were transplanted into the field at a population of 77,511 plants per ha (31,363/A). All plots were covered with a uniform 5 cm (2 in.) straw mulch to maintain desired soil temperatures. Temperature plots were individually irrigated to help maintain uniform soil moisture. The experimental design was a split plot with two replica-

tions. Soil temperatures were the whole plots, and fertility levels were subplots.

The rate of plant development in terms of plant height, leaf number, and leaf width (last fully-developed leaf on each plant) was determined weekly. Tasseling and silking dates, along with general plant appearance, were recorded throughout the growing season. When plants of a particular treatment reached the medium dent growth stage, all plants of the center row in that treatment were harvested. Dry matter yields were determined for stalks, top leaves (ear leaf plus all leaves above), bottom leaves, husk, cob, and grain. Moisture percentages and mineral concentration at harvest of individual plant parts were also determined.

Results

Space does not allow for a summary presentation of all of the data collected, so only a small part will be shown to illustrate major responses to soil temperature and fertility.

Differences for plant growth and development were apparent after the first two or three days in the field with differential soil temperatures. Soil fertility responses appeared first at 32 C followed by 21 C, ambient, and then 10 C. At the start of the experiment, the lowest soil temperature was 10 C (50 F). This was too cold for noticeable plant growth and, consequently, fertilizer responses. It was not until the soil temperature was raised to 15 C (59 F) that fertilizer differences started to appear. Therefore, it seems logical that early planted corn does not make significant growth until the soil temperature rises above 10 C (50 F) regardless of the fertilizer applied. This is indicated in Figure 1 for leaf development and was true also for plant height.

Leaf development started first, was most rapid, and ended first at 32 C. There was little difference between 21 C and ambient either in rate of appear-

ance or final leaf number. Final leaf number was least at 10 C and most at 32 C. Two weeks after transplanting, tillers started to appear, first at 32 C and then at 21 C and ambient. No tillering occurred at 10-15 C. Tillering increased with an increase in both temperature and fertility levels. At the high P-K level at 32 C there was an average of 2.9 tillers per main stalk. These tillers produced a large number of leaves until the tillers started to die off. Death of the tillers occurred just prior to mid-silking as indicated in Figure 1. At low P-K levels, leaf development was similar to that at high P-K except that the differences between 10 and 32 C were more marked. Tiller development at low P-K occurred only at 32 C.

Plant height development during the early part of the growing season was similar to that of leaf development except that differences between treatments were smaller. Plant height did not increase until soil temperature at 10 C was increased to 15 C. Plant height leveled off two weeks earlier at 32 C than at ambient or 21 C, and a month earlier than 10 C. Although plants matured first at 32 C, final plant height was 50 to 60 cm higher at maturity for ambient and 21 C. Increased fertility increased the rate of plant height development at the beginning of the season, but the slower developing plants were generally higher at maturity. This was true for all fertilizer treatments except those at 10 C, where the high fertility plots were highest at the end of the growing season. Time to tasseling, silking, and maturation was shortened with increased soil temperatures and increased P-K levels.

Soil temperature and P-K levels had a significant effect on dry matter production. This was especially true with regard to grain. The percentage of stalks varied from 25 to over 40% of the total. The lower percentages of stalk and, consequently, the higher percentages of grain were always associated with high fertility and more desirable soil temperature (ambient or 21 C). These

data are presented in Table 1. Grain yields in bushels per acre ranged from 6.2 at 10 C - low fertility, to 179.6 at ambient - high fertility. At low fertility, grain yeilds increased with increased soil temperature. However, at the two higher P-K levels yields were lowest at 10 C and 32 C, and highest at the more desirable soil temperature of 21 C or ambient. Differences due to fertility were greatest at the more disirable temperature and least at the temperature extremes.

The effects of soil temperature and P-K levels on the mineral contents of various plant parts were less marked than for plant growth characteristics. Percent P and K in the plant generally increased with increased temperature. Highest percentages were in the stalk. Percentages were generally increased with increased P and K applications.

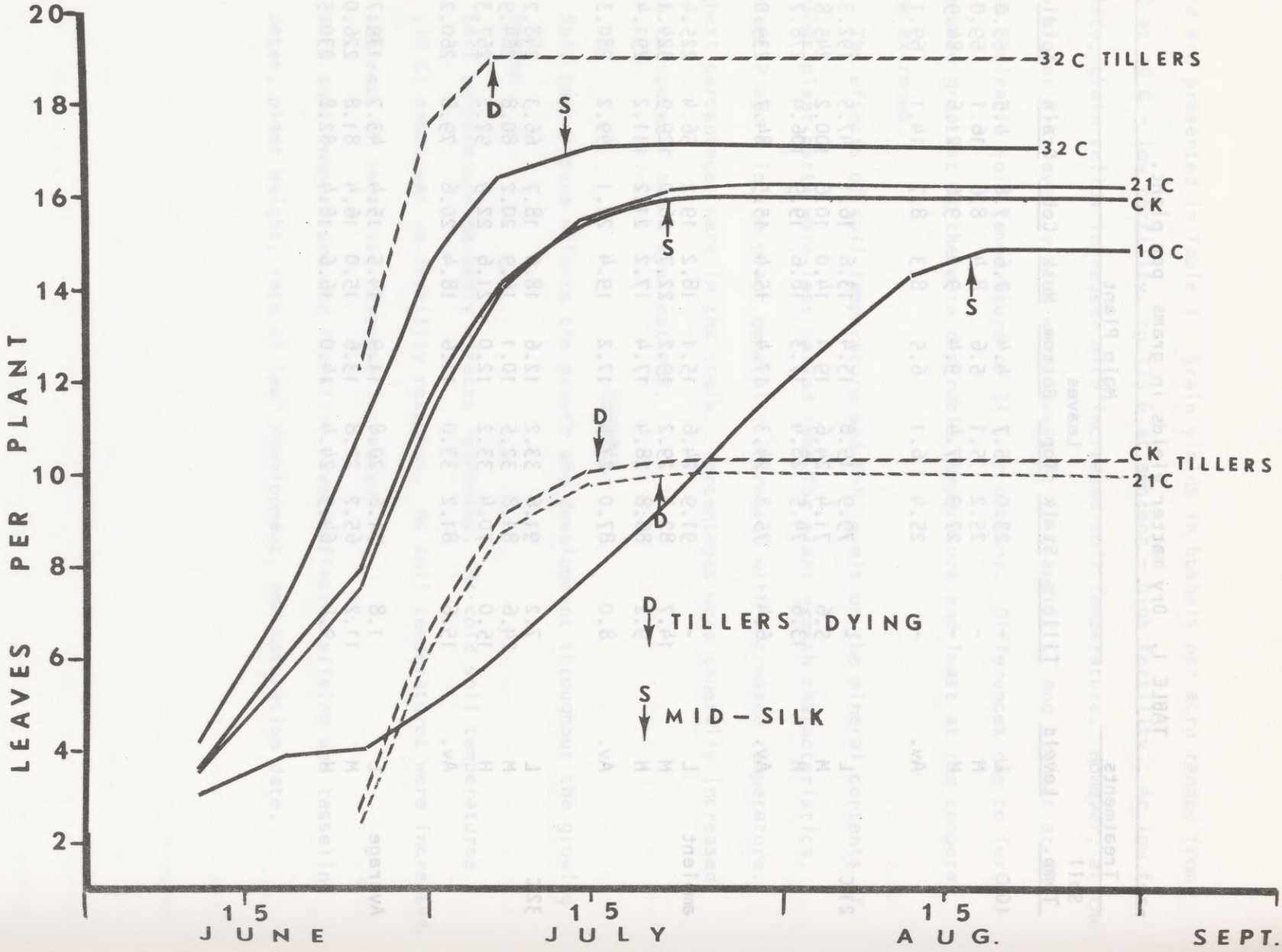
Summary

1. Soil temperature affects the growth and development throughout the growing season.
2. Soil temperature markedly affects responses. At cold soil temperatures (10 C) there was no fertility response. As soil temperatures were increased, the rate of fertility response increased.
3. Both soil temperature and fertility levels affected silking and tasseling dates, plant height, rate of leaf development, and maturation date.

TABLE 1. Dry matter yields in grams per plant.

Treatments		Main Plant							
Soil Temp.	Levels	Tillers	Stalk	Leaves Top	Leaves Bottom	Husk	Cob	Grain	Total
10 C	L	-	23.0	5.7	4.4	7.6	7.8	4.5	53.0
	M	-	25.2	5.1	5.6	8.4	8.6	16.1	69.0
	H	-	27.9	7.4	9.4	9.0	9.6	21.6	84.9
	Av.	-	25.4	6.1	6.5	8.3	8.7	14.1	69.1
21 C	L	-	79.9	19.8	15.4	13.6	16.1	47.5	192.3
	M	5.6	71.4	24.6	19.4	14.0	10.6	100.2	245.8
	H	13.6	74.5	28.4	17.3	18.6	19.9	106.4	278.7
	Av.	6.4	75.3	24.3	17.4	15.4	15.5	84.7	239.0
ambient	L	-	91.9	24.6	15.1	18.2	19.2	56.4	225.4
	M	14.7	82.4	29.2	19.2	22.7	26.0	129.9	324.1
	H	9.2	86.8	28.4	17.4	17.2	21.2	111.2	291.4
	Av.	8.0	87.0	27.4	17.2	19.4	22.1	99.2	280.3
32 C	L	7.2	91.6	33.2	12.6	18.6	18.7	66.3	248.2
	M	24.6	81.8	32.5	10.1	14.9	20.2	80.8	264.9
	H	15.0	70.4	33.2	12.0	21.6	22.9	92.2	267.3
	Av.	15.6	81.2	33.0	11.6	18.4	20.6	79.8	260.2
Average	L	1.8	71.6	20.8	11.9	14.5	15.4	43.7	179.7
	M	11.2	65.2	22.8	13.6	15.0	16.4	81.8	226.0
	H	9.4	64.9	24.4	14.0	16.6	18.4	82.8	230.5

FIGURE 1. LEAF DEVELOPMENT AT HIGH P & K LEVEL



Micro-Sampling of Soils

C.E. Robinette, J.E. Foss, and A.J. Powell [1]
Department of Agronomy

Purpose and Objectives

In sampling soils for characterization or genesis studies, samples are generally taken from the middle of the major horizons, thus avoiding margins or gradations between horizons. Similarly, in most soil fertility studies, composite samples are taken from the plow layer when sampling cultivated fields or from the surface three to four inches when sampling turf areas. By these sampling methods, variability of soil parameters between and within soil horizons cannot be adequately determined. The purpose of this study was to reevaluate the presently accepted soil sampling technique with the following objectives in mind:

(1) To evaluate extractable nutrient distribution in soils;

(2) To study morphological soil parameters, in particular argillic horizons and lithologic discontinuities, and to look at ion movement;

(3) To compare micro with normal sampling methods.

Procedures

The micro-sampling technique employed in this study consisted of sampling soil profiles at one inch increments. Soil samples were obtained in this manner from (1) Ap and B horizons in seven cultivated fields, (2) three golf course greens and (3) five complete soil profiles.

The vegetation types in the cultivated fields were corn (conventional and no-till), wheat, and alfalfa. The cultivated soil types

[1] Dr. A.J. Powell is currently at Virginia Polytechnic Institute and State University.

studied were Beltsville silt loam, Chillum silt loam, Myersville silt loam, Corydon silt loam, Duffield silt loam and Penn silt loam. Soils at the golf greens were derived mainly from micaceous material similar to the Manor or Chester soils. The complete soil profiles sampled were Beltsville silt loam under grassland, Delanco silt loam under corn, Matapeake silt loam under corn, Mattapex silt loam under loblolly pine, and Othello silt loam under corn. A soil probe was used to extract samples from cultivated fields, golf course greens, and the Matapeake and Othello silt loam soil profiles while the Beltsville, Delanco, and Mattapex profiles were sampled in one-inch increments from a pit face. The cores were then divided into one-inch sections for analysis. Duplicate profiles were taken on the golf greens and triplicate profiles in cultivated areas. Laboratory analysis included pH and available P_2O_5, K_2O, Ca, and Mg. Soil tests were run according to procedures outlined in Agronomy Mimeo 37, 1969. Mechanical analysis was conducted on the Beltsville, Mattapex and Othello soil profiles using the pipette method.

Results

Figure 1 shows the variability of P_2O_5 content with depth in three golf greens, ranging from 4 to 40 years of age. The P_2O_5 distribution in the 40 year old green is of particular interest. It increased from 325 pp2m at one inch up to 2200 pp2m at the six-inch depth and then dropped to 260 pp2m at nine inches. Without micro-sampling, such extreme variability in nutrient content within short distances would be very difficult to detect; in fact, normal agriculture sampling would give only an average value for the depths sampled.

The importance of sampling at one-inch increments is further exemplified when viewing the variation of extractable K_2O in cultivated fields as shown in Figure 2. The Corydon soil is under alfalfa and has been top-dressed for the past four years with 150 lbs of K_2O. Extractable K_2O con-

tent is 610 pp2m at the surface and gradually decreases to 160 pp2m at the bottom of the plow layer, thus indicating leaching of K downward under this management practice.

The distribution of extractable Ca and Mg in the Mattapex profile shown in Figure 3, indicates a phenomena similar to that discovered on "Kitchen Midden" soils in southern Maryland. This soil was farmed extensively 20 years ago and lime was applied. However, the Ca has been leached from the surface horizon and has apparently accumulated in the B2t horizon since these soils (where uncultivated) normally contain very little Ca in the subsoil. Magnesium levels are normally high in the subsoil, but in this case, Mg is much lower in the subsoil. It is surmised that Ca is leached from the Ap, then moves into the B2t where it replaces Mg from the exchange complex. The Mg is subsequently leached from the solum. The detailed nature of these Ca and Mg curves could not have been obtained without micro-sampling.

The technique was used to great advantage in studying argillic horizons and lithologic discontinuities as shown in Figure 4 on the Othello silt loam profile. The percent clay curve shows the clarity and sharpness with which argillic horizons may be defined while the percent sand curve indicates the exact location of the lithologic discontinuity at the 32-inch level. Figure 5 shows the additional and much more accurate information on clay distribution obtained from the micro-sampling technique as compared to the normal sampling method. Samples were collected from the Mattapex profile, both by normal sampling and by sampling in one-inch increments. Normal sampling gives a less accurate impression of the actual shape and extent of the argillic horizon in that maximum clay accumulation is 17% and occurs in the B1 horizon. To the contrary, micro-sampling gives a maximum clay accumulation of 21%, a 4% difference, and this maximum

occurs in the B2t horizon.

Summary

A micro-sampling technique was employed in which cultivated fields, golf greens and complete soil profiles, were sampled in one-inch increments to study nutrient distribution and morphological soil parameters. Comparisons of this method of sampling with normal sampling procedures were made.

Micro-sampling proved to be a valuable tool in detailed studies of nutrient distribution in soils. Furthermore, in detailed morphological studies of soils, micro-sampling proved to be superior to normal sampling in describing argillic horizons and lithologic discontinuities.

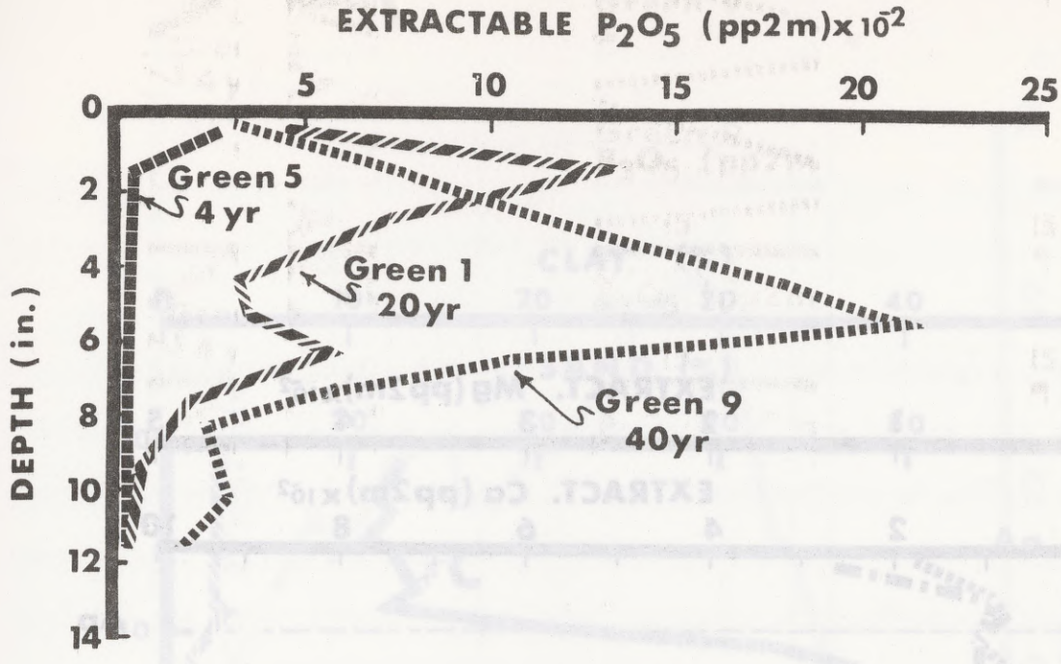


Figure 1. Extractable P_2O_5 content, in one-inch increments, in three golf course greens.

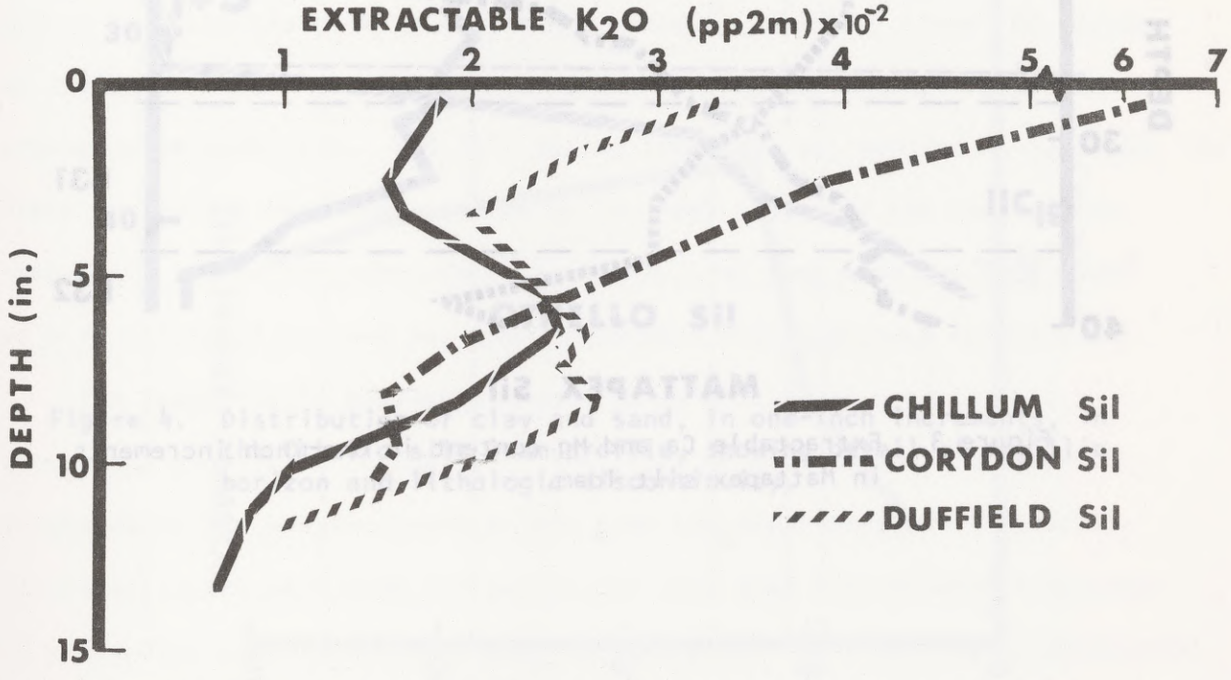


Figure 2. Extractable K_2O content in the Ap and B horizons of Chillum silt loam under corn, Corydon silt loam under alfalfa, and Duffield silt loam under corn.

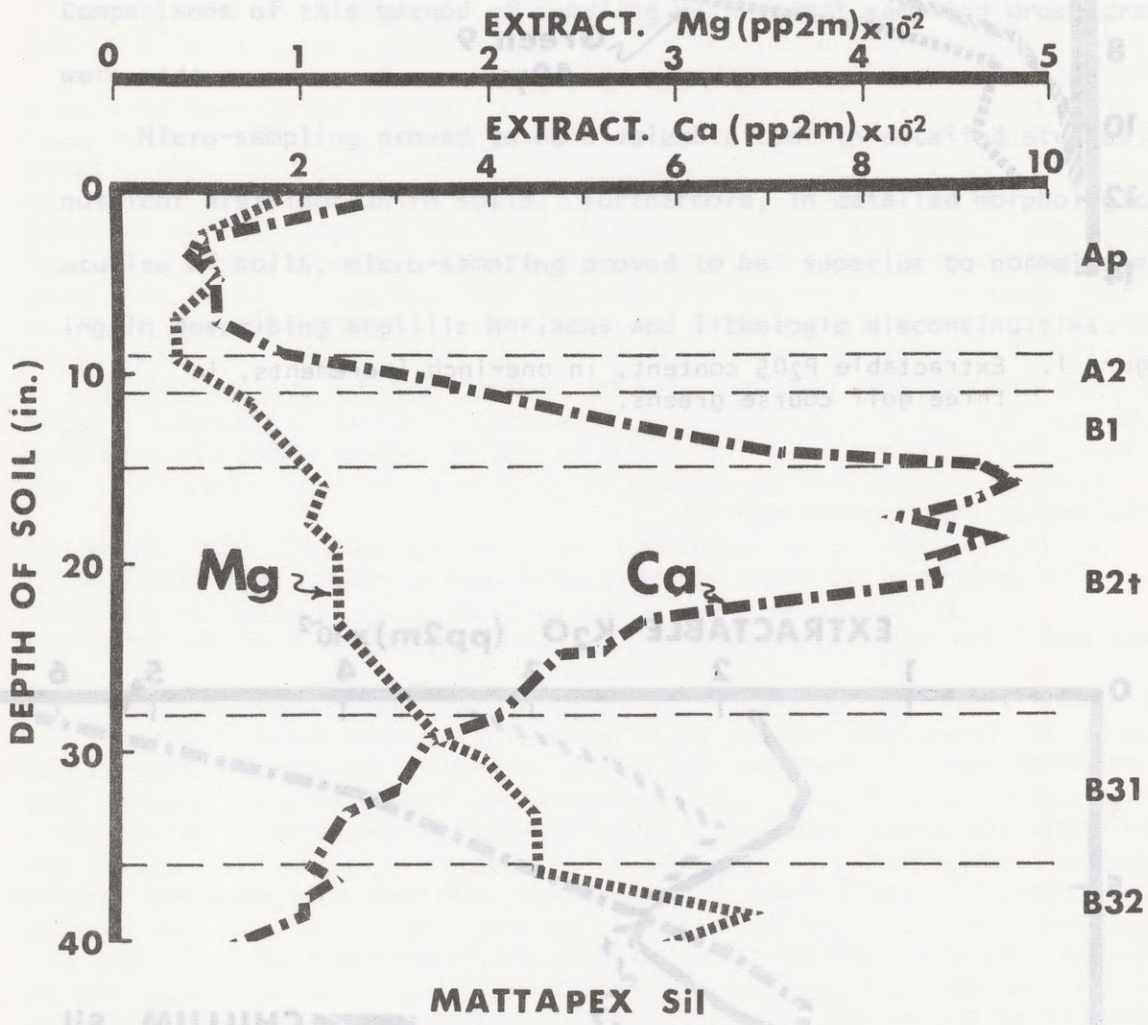


Figure 3. Extractable Ca and Mg content in one-inch increments in Mattapex silt loam.

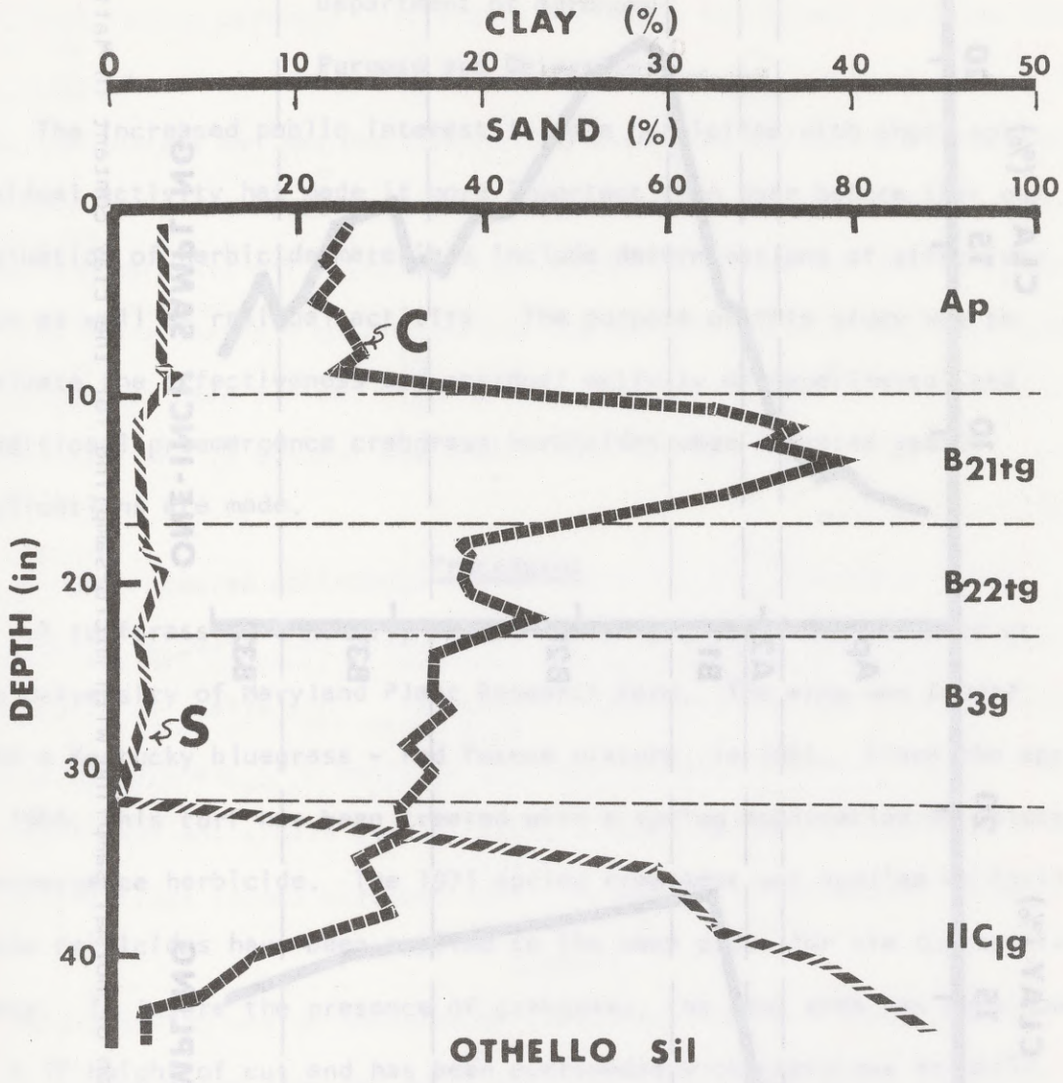


Figure 4. Distribution of clay and sand, in one-inch increments, in the Othello silt loam profile, showing detail of argillic horizon and lithologic discontinuity.

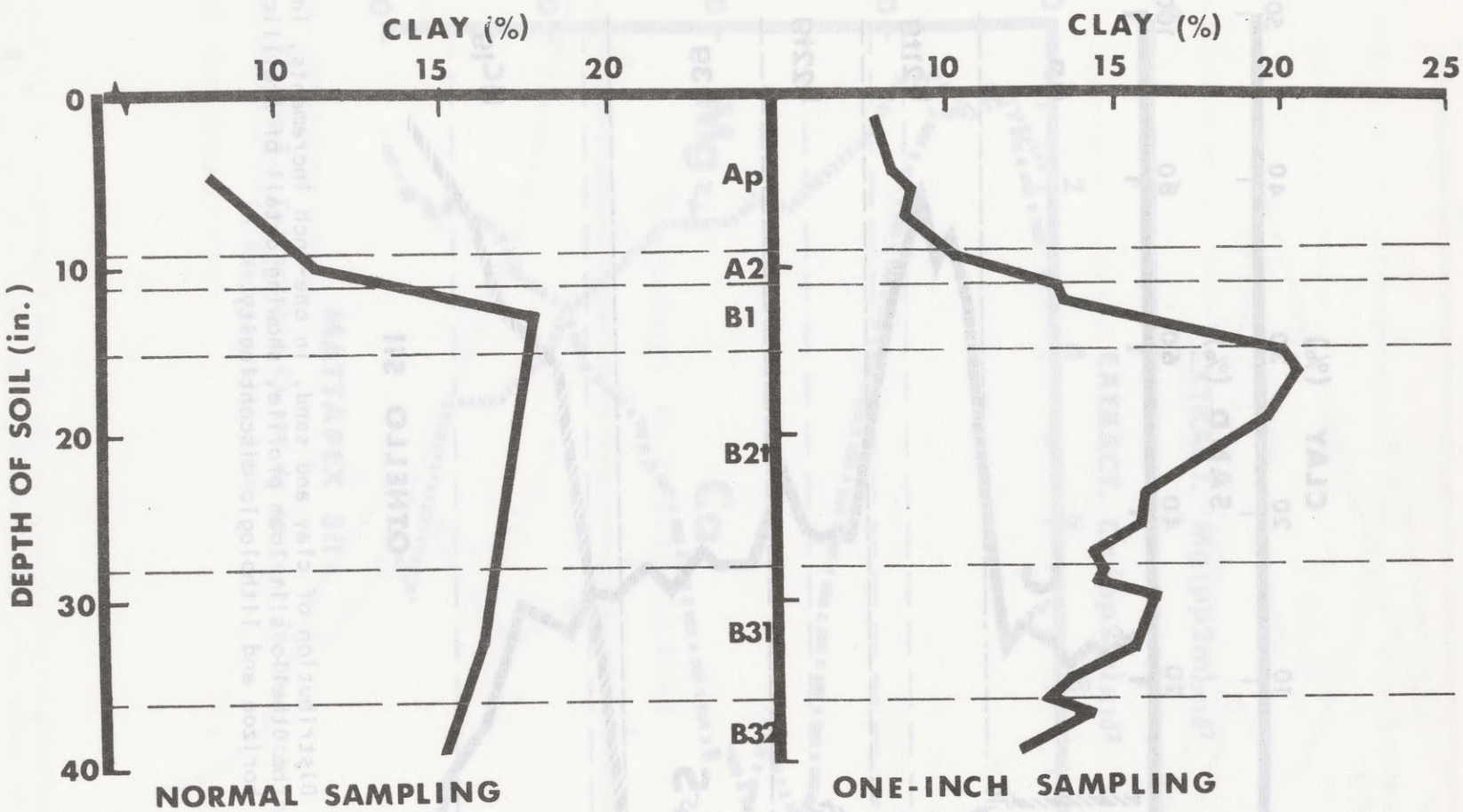


Figure 5. Comparison of normal sampling with micro-sampling for the clay content in Mattapex silt loam.

Effectiveness and Residual Properties of Several Herbicides Used in Turfgrass Areas

J. R. Hall
Department of Agronomy

Purpose and Objectives

The increased public interest in safe herbicides with short soil residual activity has made it more important than ever before that our evaluation of herbicide materials include determinations of effectiveness as well as residual activity. The purpose of this study was to evaluate the effectiveness and residual activity of experimental and traditional preemergence crabgrass herbicides when repeated yearly applications are made.

Procedures

A turfgrass area heavily infested with crabgrass was selected at the University of Maryland Plant Research Farm. The area was seeded with a Kentucky bluegrass - red fescue mixture in 1965. Since the spring of 1966, this turf has been treated with a spring application of selected preemergence herbicide. The 1971 spring treatment was applied on April 19, 1971. These herbicides have been applied to the same plots for six consecutive years. To insure the presence of crabgrass, the plot area has been mowed at a 1" height of cut and has been overseeded with crabgrass annually.

The commercially available preemergence herbicides used in this experiment are listed in Table 1. The rates of application are those suggested by the manufacturers at the time the experiment was initiated. Visual estimates were made for percent of plot area covered with crabgrass (% crabgrass) and overall turf quality (Quality). Turf quality is determined by considering percent crabgrass, density, color, texture, vigor and general appearance on a 1 to 9 scale. Nine is equivalent to the highest quality obtainable.

Results

Bandane, Bensulide, DCPA, Tricalcium Arsenate and granular Siduron gave excellent control of crabgrass (Table 1). Repeated annual applications of Bandane severely injured the turf. The bluegrass in the bluegrass - red fescue mixture has been severely thinned and the red fescue has been totally removed from the Bandane plot. Repeated applications of the other materials have not severely reduced turf quality. The tricalcium arsenate plots have been visibly stunted and are exhibiting a darker green cast than the other plots, however, overall turf quality has not been reduced in this plot. The turf quality of the check plots was reduced by the severe crabgrass infestations.

Where crabgrass invasion occurred and comparison between granular and sprayable formulation could be made, it appeared that granular materials generally provided the best crabgrass control. This effect is likely the result of the extended chemical activity obtained with granular formulations. The injury observed on the Bandane plots is very likely the result of a buildup of this material in the soil from repeated annual applications.

Summary

Preemergence chemicals currently recommended by the University of Maryland for crabgrass control continue to be the most effective herbicides. These recommended herbicides are providing effective crabgrass control with apparently minimal annual residual carryover and little effect on turf quality. Bensulide, DCPA, and Siduron, continued to provide excellent crabgrass control with maximum safety and minimum residual carryover from year to year. In most instances granular formulations provided better crabgrass control than sprayable formulations. This data indicates that continued use of environmentally stable chemicals such as Bandane can be detrimental to turf quality.

TABLE 1. Crabgrass control and turf quality after six annual applications of preemergence herbicides. Data was recorded on October 28, 1971 and is presented as a mean of four replications.

HERBICIDE[1]	A.I. Per acre lb.	%Crabgrass	Turf Quality[3]
Bandane g	35	0	1.0
Bensulide g	10	0	6.7
Bensulide ec	10	0	7.0
DCPA g	11	0	6.5
DCPA wp	11	0	7.7
Tricalcium Arsenate g	375	0	6.5
Siduron g	10	0	6.5
Siduron wp	10	6.2	6.2
Terbutrol wp	10	6.2	5.0
Terbutrol g	10	7.5	6.0
Benefin g	1.5	11.2	5.7
Benefin ec	1.5	18.7	6.0
Check[2]	0	39.9	4.12

1. g= granular, ec=emulsifiable concentrate, wp=wettable powder.

2. check is mean of eight replications

3. Rating Scale: 9=best turf quality 1=very poor turf quality

Effects of Ozone on Kentucky Bluegrass

G. Richards, C. L. Mulchi and J. R. Hall
Department of Agronomy

Purpose and Objectives

Plant injury due to air pollution is becoming more frequent in the Washington, D. C. area. Damage to turf grasses is becoming commonplace following inversion periods. Ozone is the most abundant oxidant appearing in the complex mixtures of pollutant gasses found in the air during inversion periods.

Ozone enters the plant leaves via the stomata, just as carbon dioxide enters. Factors which regulate the opening and closing of the stomata are also important in regulating the response of plants to air pollutants.

In the present study, the primary objectives were to determine the effects of long-term, low-level exposure of selected bluegrass varieties to ozone with primary interests in acute vegetation damage and regrowth rates.

Procedures

In the fall of 1971, plugs four inches in diameter were cut from established plots of seven varieties of Kentucky bluegrass *Poa pratensis*. The plugs were placed in cans and transferred to the greenhouse. While in the greenhouse the grasses were watered, fertilized and clipped on a regular basis until exposed to their respective treatments. Temperatures in the greenhouse ranged from 60 to 70°F. The ambient oxidant levels in the greenhouse remained very low during the pre-exposure period since the oxidant levels in the outside atmosphere are normally very low during winter months.

Eight cans of each variety were selected, two groups containing three plugs each and two plugs for controls. One day prior to initiating treatments the grasses were clipped at 2.5 inches. The plugs to be exposed to

the treatments were placed in a fumigation chamber equipped with lights, temperature controls and air filters. Treatments imposed were exposure to ozone levels of 0.1 ppm for periods of 3.5 hours and 7.0 hours per day for five days. The plants were watered prior to exposure and removed to the greenhouse after each exposure. Air temperatures in the chamber were $75 \pm 3^{\circ}$ F during exposure periods.

After the treatment period, the plants were returned to the greenhouse and vegetation damage ratings (0=no damage to 10=50% leaves killed) were made on the third day. Regrowth measurements were made on the third and tenth day following the last day of exposure in the chamber.

Results

A summary of data for both the vegetation damage ratings and regrowth measurements is included in Table 1. In general, the 7 hours per day exposure caused approximately twice the vegetation damage as the 3.5 hour per day treatment with the S. Dakota and Kenblue varieties being damaged the greatest. Newport appeared to have the greatest resistance to ozone damage and Southport, Merion, Fylking and Windsor falling intermediate in susceptibility. These treatments represented typical levels of ozone found in the atmosphere in the Washington, D. C. area during an inversion period.

The regrowth data, expressed as percent of control, on an overall basis shows little difference between the 3.5 and 7.0 hour per day treatments. However, there are several very interesting points regarding the regrowth data. Newport showed no visual damage at the 3.5 hour treatment yet its growth rates were reduced substantially. This supports observations by workers using other species. Visible vegetation damage is not necessary to induce reduction in growth rates. There is, however, a general trend that

the varieties which were damaged the greatest had the greatest reduction in growth which would be anticipated due to reduced leaf area for photosynthetic activity. A third point regarding regrowth is that there was no rapid recovery from the initial damage within ten days. This suggests that severe damage is inflicted to the biochemical mechanisms rather than a temporary disruption of activity.

Summary

A long-term, low level exposure to ozone is very damaging to several common bluegrass varieties both in terms of visible vegetation damage and to the biochemical mechanisms which support growth. Each variety responded somewhat differently to treatments suggesting a range in susceptibility among bluegrass varieties to ozone damage. Research to characterize the effects of ozone on growth processes is needed to fully understand the nature of the effects of air pollution on turf varieties.

Table 1. Effects of long-term, low-level exposure of selected bluegrass varieties to 0.1 ppm ozone concentrations in the atmosphere.

	Treatments					
	3.5 hrs/day for five days			7 hrs/day for five days		
		% Regrowth 2/			% Regrowth	
Variety	Damage Rating 1/	3 Days	10 Days	Damage Rating	3 Days	10 Days
Newport	0.0	79.0	85.4	1.3	85.2	88.8
Southport	1.0	84.9	82.4	2.3	83.6	81.2
S. Dakota Certified	2.0	78.2	75.5	3.3	78.2	74.5
Merion	1.7	79.2	78.1	2.7	76.8	71.2
Kenblue	2.3	78.8	69.8	3.3	77.5	72.9
Fylking	1.7	71.6	76.1	2.7	70.4	77.4
Windsor	1.3	78.2	70.0	3.0	75.0	66.7
Mean ($\bar{X}$)	1.4	78.6	76.8	2.7	78.1	76.1

1/ - 0 = no damage, 10 = 50% of leaf blade killed

2/ - Expressed as percent (%) of control

Evaluation of Kentucky Bluegrass Varieties for Turf

J. R. Hall
Department of Agronomy

Purpose and Objectives

Each year in Maryland thousands of professional and amateur turfgrass managers are confronted with the problem of choosing a bluegrass or blend of bluegrasses for renovation or establishment of turf. It is the purpose of this test to evaluate new experimental and commercial bluegrass varieties to determine which varieties or blends of varieties are most likely to provide a quality turf in Maryland.

The objectives of this study were:

1) To compare bluegrass varietal performance at two locations and two mowing heights.

2) To observe the persistence of bluegrass varieties and blends in Maryland transitional climate.

Procedure

In the fall of 1968 42 Kentucky bluegrass clones were seeded in a randomized complete block experimental design with three replications. Two vegetative clones (Warren's A-10 and A-20) were sodded into vacant plots in the fall of 1969. The basic experiment is located at Hopkins Plant Research Farm and includes all 44 varieties fertilized at the rate of 3 lbs. N/1000 ft.^{2}/yr. and maintained at a 1 1/2" mowing height. Supplementary tests were established simultaneously at Centreville and at the Hopkins Plant Research Farm but are maintained at a 2 1/2" mowing height. Due to a shortage of seed, seven of the original 42 seeded varieties were excluded from the supplementary tests.

All experiments were rated monthly from April through November for color, density and quality. When diseases were present, the varieties were rated for resistance. The most important rating is the quality rating which is based upon overall appearance and desirability of the turf. The quality rating in this experiment takes into account density, coarseness, color, texture, disease damage, vigor and aesthetic value. Quality ratings are taken on a 1 to 9 scale with 9 equivalent to the highest quality obtainable and 1 equivalent to almost bare soil. Percentile rank expressions allow the cross referencing of variety performance from one set of experimental conditions to another. The variety at the 100 percentile rank exhibits the highest quality. If a variety is at the 50 percentile rank there are approximately 50 percent of the varieties in the test performing better and 50 percent performing worse.

Plots at the Hopkins Plant Research Farm were mowed twice weekly from April through November and were not irrigated unless the experiment was threatened. Plots at Centreville were mowed infrequently and were never irrigated. The plots at Centreville are maintained with minimal maintenance.

Results

None of the 34 varieties tested at all three locations were capable of performing above the 80th percentile at every location (Tables 1, 2 and 3). Generally, the improved varieties performed well at Hopkins farm where management was intense and the common varieties were superior at Centreville where management was inferior.

Of the 34 varieties tested in both experiments at Hopkins farm, only Fylking, Weibulls 411, Weibulls 412, and Merion were capable of performing above the 80 percentile rank at both mowing heights (Table 1). Varieties

performing below the 20 percentile rank at both mowing heights at Hopkins farm were Delta, Nuggett, NJE-P-5 and NJE-P-56. Exhibiting its ability to persist under less intensive management, Delta moved up to the 74 percentile rank at Centreville. Other varieties exhibiting superior performance at Centreville were Belturf, Newport, Vantage, Windsor, K8-144, K8-145 and Kenblue (Table 3).

The data indicates that the performance of some varieties was severly affected by the height of mowing at Hopkins Farm (Table 1). Belturf, Arista, Vantage and Sodco all dropped more than 20 points in Percentile rank when mowed at the higher mowing height. Rhode Island PP-1, Primo, K8-145, Sydsport, South Dakota certified and Cougar all gained at least 23 points in Percentile rank when mowed at the higher mowing height. This suggests that in variety evaluation the selection of mowing height is critical.

Dollar spot susceptibility ratings taken at the 1 1/2" mowing height in July of 1971 indicate that Sydsport, Nuggett, Fylking, Delta, K8-146, K8-145 and K8-144 were very susceptible to this disease. Varieties exhibiting exceptional resistance to dollar spot damage were PSU K-162, Warren's A-10 and Belturf.

Summary

The data clearly indicates that no one of the 44 varieties performs best under all conditions. Recommendations made from these variety trials for Maryland lawns should include mixtures of at least three varieties performing well in these tests. Selection of varieties for inclusion in a Maryland blend should utilize both common and improved Kentucky bluegrass varieties. Comparison of the 1971 data with the three year average data

indicates that some varieties such as Warrens A-20, WK-411, NJE P-115, Merion and WK-412 are improving rapidly. Each year new information about disease susceptibility, persistance and quality will be collected and affect individual variety ratings. It is likely that some varieties that appear strong now will degenerate from thatch-borne diseases and other maladies associated with older turf. With this in mind, one should realize that the Percentile rank of some varieties will change in subsequent years.

Table 1. Quality ratings and Percentile ranks of Kentucky bluegrass clones maintained for three years at a 1 1/2" mowing height at Hopkins Plant Research Farm.

Variety	Hopkins Farm 1 1/2" 1969	1970	1971	Ave.	Percentile Rank
Warren's A-20	6.23	6.58	8.09	6.96	100
Fylking	6.09	7.55	6.39	6.67	98
WK-411	5.53	6.04	8.23	6.60	95
Warren's A-34	5.24	6.37	7.35	6.31	93
Belturf	5.77	6.20	6.16	6.04	91
NJE P-115	5.53	5.87	6.69	6.03	89
WK-412	5.47	5.70	6.55	5.90	87
Merion	5.43	5.66	6.52	5.86	84
Newport	5.24	5.91	6.42	5.85	82
Arista	6.00	5.79	5.79	5.85	80
Mer, Fyl, Penn	5.41	5.62	6.34	5.79	77
PSU K-107	5.41	5.79	6.12	5.77	75
RI-PP1	4.99	5.54	6.74	5.75	73
Zwartberg	5.91	5.58	5.73	5.73	71
Campus	5.66	5.41	5.93	5.66	68
K8-146	5.63	5.50	5.80	5.64	66
Vantage	4.53	6.12	6.28	5.64	64
Windsor	5.29	5.58	6.02	5.62	61
Pennstar	5.39	5.66	5.80	5.61	59
WK-408	5.26	5.70	5.84	5.59	57
K8-144	5.51	5.25	5.80	5.51	55
Primo	4.51	5.75	6.22	5.49	52
PSU K-128	4.93	5.16	6.26	5.44	50
Park	5.47	5.41	5.43	5.43	48
NJE P-35	4.23	5.25	6.69	5.38	45
Adelphi	4.71	5.16	6.27	5.37	43
Sodco	4.94	5.29	5.90	5.37	41
PSU K-162	4.91	5.16	6.00	5.35	39
Palouse	5.37	5.45	5.23	5.34	36
Jacklins S-21	5.10	5.41	5.52	5.34	34
Prato	5.56	5.00	5.43	5.33	32
k8-145	5.56	5.04	5.42	5.33	30
Warrens A-10	6.33	3.91	5.54	5.25	27
Minn-6	5.26	5.00	5.25	5.16	25
NJE P-114	4.89	4.99	5.59	5.15	23
Kenblue	4.61	5.04	5.76	5.13	20
Geary	5.13	4.91	5.09	5.04	18
NJE P-56	4.23	4.87	5.90	5.00	16
Sydsport	4.27	4.78	5.90	4.98	14
South Dakota Cert.	5.49	4.06	4.48	4.67	11
NJE P-5	3.77	4.55	5.67	4.64	9
Cougar	4.10	4.70	4.79	4.52	7
Nuggett	5.06	4.33	4.06	4.48	5
Delta	3.81	4.08	4.09	3.99	2

Table 2. Quality ratings and percentile ranks of Kentucky bluegrass clones maintained for three years at a 2 1/2" mowing height at Hopkins Plant Research Farm.

Variety	Hopkins Farm 2 1/2" 1969	1970	1971	Ave.	Percentile Rank
Fylking	5.86	6.37	7.14	6.45	91
WK-411	5.69	6.45	7.00	6.37	85
Belturf	5.23	5.95	5.73	5.63	29
WK-412	5.80	6.62	6.96	6.45	94
Merion	5.79	6.83	7.65	6.74	100
Newport	5.84	6.08	6.52	6.14	71
Arista	5.43	6.00	6.69	6.04	57
Mer, Fyl, Penn	5.76	6.08	6.98	6.37	89
PSU K-107	5.56	6.25	6.98	6.25	80
RI-PP1	5.43	6.50	7.47	6.46	97
K8-146	6.26	6.16	6.35	6.25	77
Vantage	4.64	5.95	6.76	5.77	34
Windsor	5.61	5.95	5.91	5.81	43
Pennstar	5.37	5.91	6.72	6.00	54
WK-408	5.39	5.95	6.24	5.85	46
K8-144	5.63	6.04	6.50	6.05	60
Primo	5.66	6.50	6.84	6.32	83
Park	5.77	6.12	6.27	6.05	63
Sodco	4.86	5.33	6.34	5.50	17
Palouse	5.51	5.83	6.39	5.90	51
Jacklins S-21	5.56	6.04	6.13	5.90	49
Prato	5.44	5.41	6.05	5.62	26
K8-145	5.94	6.04	6.43	6.13	69
Minn-6	5.33	5.45	6.01	5.59	23
NJE P-114	4.84	5.33	6.15	5.43	11
Kenblue	5.34	5.70	5.68	5.56	20
Geary	5.23	5.62	6.06	5.63	31
NJE P-56	4.53	4.83	5.73	5.03	3
Sydsport	4.67	6.33	7.30	6.10	66
South Dakota Cert.	5.71	5.87	5.76	5.78	40
NJE P-5	4.70	5.33	5.80	5.27	6
Cougar	5.14	6.04	6.15	5.77	34
Nuggett	5.09	5.50	5.84	5.47	14
Delta	4.97	5.41	5.81	5.39	9

Table 3. Quality ratings and Percentile rank of 35 Kentucky bluegrass clones maintained for three years at a 2 1/2" mowing height at Centreville, Maryland.

Variety	Centreville 2 1/2" 1969	1970	1971	Ave.	Percentile Rank
Warren's A-20	---	---	---	---	---
Fylking	3.62	4.88	4.82	4.44	29
WK-411	3.30	4.77	5.87	4.64	57
Warren's A-34	3.43	4.94	5.57	4.64	60
Belturf	3.67	5.10	6.33	5.03	100
NJE P-115	---	---	---	---	---
WK-412	3.50	5.33	5.41	4.74	69
Merion	3.17	5.49	5.12	4.59	49
Newport	3.52	5.38	5.87	4.92	91
Arista	3.38	3.89	4.95	4.07	3
Mer, Fyl, Penn	3.78	4.88	5.16	4.60	51
PSU K-107	3.45	4.44	5.20	4.36	20
RI PP1	3.73	5.33	5.53	4.86	77
Zwartberg	---	---	---	---	---
Campus	---	---	---	---	---
K8-146	---	---	---	---	---
Vantage	3.28	4.99	6.83	5.03	97
Windsor	3.67	5.05	5.99	4.90	89
Pennstar	3.20	4.83	4.33	4.12	6
WK-408	2.95	4.71	5.62	4.42	23
K8-144	3.77	5.16	5.99	4.97	94
Primo	3.17	4.99	5.20	4.45	31
PSU K-128	---	---	---	---	---
Park	3.13	4.42	5.24	4.26	11
NJE P-35	---	---	---	---	---
Adelphi	---	---	---	---	---
Sodco	3.22	4.77	5.49	4.49	37
PSU K-162	---	---	---	---	---
Palouse	3.25	4.38	5.28	4.30	14
Jacklins S-21	3.18	5.21	5.37	4.58	46
Prato	3.90	5.27	5.03	4.73	66
KB-145	3.67	4.99	6.03	4.89	86
Warren's A-10	---	---	---	---	---
Minn-6	3.15	5.21	5.99	4.78	71
NJE P-114	3.42	4.66	5.37	4.48	34
Kenblue	3.50	4.77	6.32	4.86	80
Geary	3.12	4.55	6.03	4.56	43
NJE P-56	3.17	4.60	5.33	4.36	17
Sydsport	3.07	4.77	5.66	4.50	40
South Dakota Cert.	3.33	4.77	5.78	4.62	54
NJE P-5	3.10	4.55	5.66	4.43	26
Cougar	3.47	5.05	5.45	4.65	63
Nuggett	3.55	4.60	4.49	4.21	9
Delta	3.65	5.33	5.58	4.85	74

Forage Double-Cropping Utilizing No-Tillage Planting

Lenat Hofmann
Department of Agronomy

Purpose and Objectives

Growing two crops on the same site in one season is a way farmers can increase crop production. This has been demonstrated on the Eastern Shore of Maryland where farmers practice double-cropping with winter barley and soybeans on the same field in one year. However, growing two crops instead of one usually results in shortening the normal growing season of at least one of the crops because planting the second one is delayed until the first can be harvested. Yields are usually reduced by delayed planting and costs are added by planting and harvesting an additional crop. Therefore, one must determine if these are compensated for by increased total production.

Recent innovations in minimum tillage reduces the time required for planting corn. This savings in time is an asset for double-cropping corn with another crop since the time from harvest of the first crop until the corn seed is in the ground is significantly reduced.

The purpose of this experiment is to compare forage production from double-cropping system to a one crop system, and compare no-tillage method of corn establishment to conventional methods.

Objectives are:

1. Compare silage yields from small grain followed by corn to yields from a corn silage crop alone.
2. Compare silage production from corn established by no-tillage planting to conventional planting.
3. Compare production utilizing small grain for grain followed by corn for silage.

Procedures

The experiment was established in the spring of 1970 at the University Agronomy Dairy Forage Research Farm, Clarksville, Maryland. The experiment was replicated three times in a split-plot design with 3 planting dates: early (full season corn), medium (small grain for silage and corn for silage), and late (small grain for grain and corn for silage) as whole plots and a conventional planting and a no-tillage planting as sub plots.

Corn planting data for 1970 and 1971 are listed in Table 1. Following corn silage harvest in 1971, plots were disked and Balbo rye was seeded to early plots, Wong barley (for silage) was seeded to medium plots, and Barsoy barley (for grain) was seeded to late plots. The rye cover was plowed down on conventional plots and killed with paraquat on no-tillage plots prior to the early corn planting treatment. Wong barley was harvested for silage yields with a plot forage harvestor and the Barsoy barley was harvested for grain yields with a field combine. No-tillage plantings were made into the barley stubble and conventional plantings were made after stubble was plowed down and a seedbed prepared.

Corn grain yields were taken in 1971 by harvesting a 40 foot row by hand. Silage yields were calculated on a 35% dry matter basis and grain yields were calculated on a 12% moisture basis.

Results

Corn silage yields for each year are reported in Table 2. Significant differences occurred in 1970 in that delayed plantings resulted in reduced yields and conventional corn produced significantly higher yields at the early and medium plantings. During 1971, no yield differences occurred between conventionally planted or no-tillage planted corn. However, delaying planting reduced yields significantly as it had the previous year.

One possible reason for the difference in yields between no-tillage planted corn and conventionally planted corn in 1970 may be the difference in fertilizer applications. Although rate per acre was the same, 20 pounds of each element was banded next to the row when planted conventionally whereas the fertilizer was top dressed prior to planting the no-till. During 1971, additional fertilizer was banded with the planter for both planting methods.

Lighter rates of fertilizer were used in 1970 than 1971 which could also have contributed some differences. The small grain following no-tillage corn plots was shorter in height and lighter in color, indicating possible nitrogen deficiency. These differences were evident for both grain silage and grain yields. Small grain received no additional fertilizer.

Wong barley, following conventionally planted corn produced 8.0 tons/A 35% dry matter silage in 1971. Barley following no-tillage corn produced 4.8 ton per acre, a significant reduction. Barsoy barley grain yields were 74.9 bushel per acre and 56.8 bushel per acre following conventional and no-till corn respectively; a significant reduction.

Corn grain yields, taken in 1971, did not vary significantly between planting methods. No-tillage produced 173.1 bushel per acre and conventional 170.6 bushel per acre at the early planting. Significant reduction because of delayed planting and for no-tillage planting occurred at the medium planting; 137.2 bushel per acre and 125.4 bushel per acre for conventional and no-tillage corn, respectively. Late planted corn did not ripen adequately to produce corn grain.

One additional observation was made on the early planting in 1971. Army worn (controlled by spraying with 1.5 pints/A Malathion) infested no-tillage planted corn plots more severely than adjacent conventionally planted

plots. Damage, rated by visual count of damage done to leaves of individual plants, averaged over 3 reps. was 32% injury on no-tillage plants and 4% injury on conventional plants. These observations further confirm the need to utilize a high degree of management to successfully produce no-tillage corn crops. Army worm were no problem at the later planting.

The comparison of double-cropping potential can be made only for 1971 data. An average of 20.8 ton per acre corn silage was produced by a single-cropping system. Double-cropping produced 8.0 tons per acre barley silage plus 14.8 tons per acre corn silage for a total of 22.8 tons forage utilizing conventional planting. Utilizing no-tillage planting, a total of 19.8 tons forage was produced from 4.8 tons per acre barley silage and 15.0 tons per acre corn silage. These data indicated a 2 ton per acre production advantage by double-cropping, but a 1 ton per acre disadvantage by couble cropping utilizing no-tillage. More data is evidently required before final conclusions as to the merits of double-cropping for forage production can be made. Following, harvests, plots were once again disked and again planted to small grains.

Summary

1. Conventionally planted corn produced greater yields of silage than no-tillage planted corn in 1970 when planted at May 13 or May 22; but, not when planted June 29.
2. During both 1970 and 1971, delayed planting resulted in significantly reducing corn silage yields.
3. In 1971, barley silage and barley grain from plots following no-tillage planting had significantly lower yields than barley following conventionally planted corn.

4. Corn grain yields in 1971 did not differ between the early no-tillage or conventional planting, but conventional tillage produced an advantage at the medium planting. The delayed planting resulted in significant yield reductions regardless of planting methods.

5. Conclusions can not be drawn from 1 year's data as to whether double-cropping forage will produce higher yields than single-cropping. Conventionally planted corn for silage plus barley for silage produced 2.0 tons per acre more forage than one crop of corn silage. However, no-tillage planted corn plus barley produced 1.0 ton per acre less forage. This study will be repeated for another year.

Table 1. Date of planting, variety used, and harvest dates for corn used in double-cropping study.

Treatment	Date of Planting	Corn Variety	Harvest Date
	1970		
Early	May 13	Pioneer 3306	September 18
Medium	May 22	Pioneer 3306	September 18
Late	June 29	Dekalb XL45	September 30

Herbicide: Conventional - 1 lb/A atrazine (AAtrex) + 1.5 lb/A butylate (Sutan) incorporated

No-tillage - 1 lb/A paraquat + spreader
1 lb/A atrazine +
1.5 lb/A alchlor (Lasso) preemergent

Early and medium also received 2 lb/A atrazine plus oil postemergent to control yellow nutsedge.

Fertilizer: Conventional: 130 lb/A each Nitrogen (N), phosphate (P_2O_5) and potash (K_2O) plowed down plus 20 lb/A each with the planter.

No-tillage: 150 lb/A each N, P_2O_5 and K_2O top dressed.

	1971		
Early	May 7	Pioneer 3369A	September 23
Medium	June 14	Pioneer 3369A	October 7
Late	July 8	Pioneer 3773	October 21

Herbicide: Conventional - 1.5 lb/A atrazine +
1.5 lb/A simazine (Princep)

No-tillage - 0.5 lb/A paraquat + spreader
1.5 lb/A atrazine +
1.5 lb/A simazine

Fertilizer: All plots received 220 lb/A each N, P_2O_5 and K_2O broadcast plus 20 lb/A each with the planter.

Table 2. Tons/A (35% dry matter) corn silage at three dates of conventional and no-tillage corn at 30 inch row spacings.

Date of Planting	Conventional	No-tillage	Average
		1970	
		Tons per acre	
Early (May 13, 1970)	21.9 a [a/]	13.3 b	19.6
Medium (May 22, 1970)	18.6 b	14.2 c	16.4
Late (June 29, 1970)	11.1 d	10.6 d	10.9
	17.2	14.0	
		1971	
Early (May 7, 1971)	20.2 a	21.3 a	20.8
Medium (June 14, 1971)	14.8 b	15.0 b	14.9
Late (July 8, 1971)	10.2 c	11.2 c	10.7
	15.1	15.8	

a/ Numbers within each year followed by the same letter are not significantly different at the 5% level of probability according to Duncan's Multiple Range Test.

Effect of Diphenamid on Weed Control and Tobacco Seedling Production

J. H. Hoyert
Department of Agronomy

Purpose and Objectives

Diphenamid sold under the trade name of Enide has been very successful in controlling grass in field tobacco in Maryland and other areas. There has been considerable interest in the effectiveness of this material for use in controlling grassy and broadleaved weeds in tobacco plant beds. Diphenamid is very inexpensive and can be applied more conveniently and rapidly than materials now being used in Maryland. However preliminary work in the greenhouse indicated that there was some risk in injuring the tobacco seedlings at germination.

Objectives of this work were to study the effect of diphenamid for the control of grassy and broadleaved weeds in a conventional tobacco plant bed and determine the yield of seedlings pulled for transplanting. Special attention was paid to phytotoxicity effects of this material on germinating seedlings.

Procedures

The experimental design was randomized complete block with four replicates situated in the regular plant bed area of the Tobacco Experimental Farm on Monmouth sandy loam soil. Md. 609 variety was seeded on April 8, 1971 in a conventional manner. Irrigation was used frequently during the germination period.

The diphenamid was sprayed over the plots on April 8, 1971. Treatments were 0 lb/A; 2 lb/A (active); 4 lb/A (active); 6 lb/A (active) and 8 lb/A (active) with 40 gallons of water per acre used for each treatment. The 4 lb. rate is recommended for field use and would be expected to be the optimum rate in plant beds.

Plot size was 4.75 ft. x 9 ft.; however, to minimize border effect all data was recorded for 2.5 ft. x 6.4 ft. Data included the stand of tobacco seedlings and grassy and broadleaved weed count on May 13, 1971 and number of transplants pulled on June 11 and June 28, 1971.

Results

Table 1 presents a summary of results from 1971. All rates of diphenamid were better than the control in the number of good transplants drawn for field use. The 2 and 4 lb. rates were superior to the 6 and 8 lb. rates in number of transplants drawn. There were severe injury symptoms at the 6 and 8 lb. rates which retarded plant growth. There was a trend toward decreased stand at the higher rates but this was not great enough to be significant. The 6 and 8 lb/A rates also resulted in the young seedlings growing slower.

The material was effective for grassy weed control with all rates being superior to the control. There were no differences between treatments in the control of broadleaved weeds. Diphenamid at the rates tested was ineffective in controlling broadleaved weeds.

Summary

In 1971 diphenamid gave satisfactory grassy weed control. Control of broadleaved weeds was inadequate at any rate. There was severe injury to the young tobacco seedlings at the higher rates of 6 and 8 lb/A and a trend toward a lowered stand of tobacco plants. This material should not be used in Maryland tobacco beds at rates of 6 lb/A (active) or higher. There would be considerable risk in using diphenamid on soils where broadleaved weeds are a problem.

Table 1. Effect of diphenamid on weed control and tobacco transplant production. 1971.

Diphenamid lbs. per acre/active	Count per Grass per sq. yd.	Count per Bdlf. Weeds per sq. yd.	Seedling* Injury Index	Tobacco Seedling Stand per sq. yd.	Tobacco Transplants Drawn per 100 sq. yds.
0	287	15	1.00	363	6,113
2	7	13	1.00	341	17,288
4	6	7	1.75	391	17,100
6	17	8	3.00	237	10,388
8	5	20	3.50	279	10,125
L.S.D. (.05)	113	N.S.	0.89	N.S.	1547
(.01)	156	--	1.24	--	2166
C.V.	11.3%	76.5%	28.7%	4.9%	33.0%

* Index of 1 to 4 with 1 being no injury and 4 being severe injury.

Effect of Sucker Control Agents, Method of Application and Time of Harvest on Maryland Tobacco

J. H. Hoyert
Department of Agronomy

Purpose and Objectives

Maryland growers have converted to the use of sucker control chemicals in the past few years. There are practical problems in the application of suckering agents brought on by the reliance of many large growers on custom operators. It is necessary for the custom operator to treat the grower's total tobacco acreage in one visit as it would be too costly to make repeat visits to the farm. It is often impossible for the grower to top his entire crop because of labor restrictions. Thus there are practical advantages for custom operators to apply sucker control agents to untopped tobacco.

Another problem resulting from decreased labor availability is that tobacco is harvested over longer periods of time after topping which could have a significant effect on quality and yield. Maryland leaf is noted for its thin body and high filling power -- quality characteristics that must be preserved.

Systemic sucker control agents are most popular in Maryland but contact type chemicals have some place on small crop acreages. Combinations of systemic and contact sucker control agents have proven profitable in the flue-cured area and should be investigated under Maryland conditions which are considerably different than flue-cured.

Consequently this study was initiated to compare sucker control agents and different methods of application. The objectives were:

1. To compare chemical suckering agents and various methods of application of these suckering agents and their effect on yield, price and acre values of Maryland tobacco.
2. To determine the effect of time between treatment and harvest for various sucker control methods, on yield, price and acre values.

Procedures

This experiment was located on a Monmouth fine sandy loam at the Tobacco Experimental Farm. Md. 10 variety was transplanted at a population of 6,223 plants per acre with 60-120-180 lbs. of fertilizer broadcast per acre and an additional 20 lbs. of nitrogen sidedressed 30 days after planting. Four replicates were used in a split plot design with the time of harvest as sub plots and sucker control methods as the whole plots.

Transplanting was carried out on June 14, 1971 and topping was completed August 16, 1971 when approximately 70% of the plants showed open flowers.

Treatments were:

1. Control -- Topped August 16, 1971 with no sucker control used.
2. Systemic -- Topped August 16 and sprayed with MH-30 at 1 pint per 1000 plants.
3. Systemic -- MH-30 at 1 pint per 1000 plants sprayed on August 13 and topped August 16.
4. Contact -- Topped August 16 and Off-Shoot-T applied.
5. Sequential -- Off-Shoot-T applied August 13, topped on August 16 and sprayed with MH-30.

There were two harvest dates of August 26, 1971 and September 7, 1971. At the time of harvest suckers were removed from the plot and weighed to determine the effectiveness of sucker control.

Yield, price per pound and acre values were computed for the cured leaf using the standard grades as established by Tobacco Division of the Consumer and Marketing Service of the U. S. D. A.

Results

Rainfall was near optimum during the 1971 season and sucker growth was heavy. The 1971 results are summarized in Table 1.

The maleic hydrazide treatment at time of topping resulted in a higher yield than the control treatment. The other methods showed a strong trend to give higher yields than the control although the differences were not significant. The earlier harvest date gave 159 lbs. more yield than the later date. This was partially because of greater sucker growth and resulting competition for the late harvest. There was also some "firing" and loss of lower leaves at the second harvest that reduced yields. The weight of suckers removed was greater where no chemical suckering agent was used. However no significant differences occurred between the various suckering chemicals employed.

Price per hundredweight of tobacco showed a consistently lowered price at the later harvest date. This was because of thicker bodied leaf resulting from this late harvest and in part because there was a larger proportion of lower value "second" grades and less of the higher valued "bright" leaf grades.

The acre values were not different among the various chemical treatments used for sucker control. The MH at time of topping and the sequential treatments gave higher acre values than the control. The early harvest date resulted in $127 more than the late harvesting.

Summary

The later harvest date resulted in substantial losses in yield per acre, price per pound and acre values. All suckering treatments were better than the check in controlling suckers. The MH used at time of topping gave an increase in yield and acre value over the control treatment. There were no significant differences in yield, price or acre values among the various suckering agents used.

Table 1. Effects of sucker control treatments and time of harvest on sucker weight, yield, price and acre values of Maryland tobacco. 1971.

Treatment	Yield	Price	$/A	Sucker Weight oz./plot
Between Chemical Treatments				
1. Control	1809	73.03	1319	271
2. Maleic hydrazide at topping	1970	72.80	1431	6
3. Maleic hydrazide before topping	1908	73.09	1395	14
4. Contact	1864	72.99	1359	30
5. Contact before topping maleic hydrazide at topping	1932	73.17	1416	6
L.S.D. .05	125	N.S.	89	92.8
C.V.	4.3%	1.3%	4.2%	92.8%
Between Dates of Harvest*				
Aug. 26, 1971	1974	73.32	1447	11
Sept. 7, 1971	1815	72.72	1320	120
C.V.	8.1%	1.1%	8.3%	81.8%

* Differences significant at .01 confidence level.

The Feasibility of Transplanting Tobacco Seedlings in Pressed Peat-Soil Cubes

J. H. Hoyert
Department of Agronomy

Purpose and Objectives

The purpose of this research was to develop new methods of growing tobacco plants which would have a potential for improving seedling uniformity. Thus, if successful, further mechanization of transplanting and a reduction in labor might be achieved. Irregular tobacco at harvest time because of non-uniform transplants is one of the major problems in total mechanization of tobacco production.

The objectives of this study were:

1. To compare the growth and uniformity of transplants in peat-soil cubes to conventional transplants.
2. To investigate the feasibility of discontinuing the use of water with peat-soil cubes.

Procedure

This experiment was situated on a Monmouth fine sandy loam soil at the Tobacco Experimental Farm. Md. 609 variety was transplanted using a modified Ellis 2-row mechanical transplanter at a plant population of 6,223 per acre. Fertilizer was broadcast at a rate of 60-120-180 lbs. per acre. Experimental design was a randomized complete block with 4 replicates. Plots were 1-row of 32 plants or 6 by 42 ft. in size with 30 plants harvested.

Treatments included were pressed peat-soil cubes and transplants pulled from a plant bed and carefully sorted and selected according to uniformity of size and shape. The control consisted of conventional trans-

plants pulled rapidly as an average grower draws seedlings with no extra attention given to uniformity. Each of these treatments were transplanted with 1/2-pint of water placed at the roots during the planting operation. The three treatments were also repeated with no water used at transplanting making a total of six treatments.

Transplanting was carried out on June 7, 1971. This period was one of adequate and well distributed rainfall and soil moisture was at an optimum level.

Ratings of early growth, vigor and uniformity were made 3 weeks after transplanting by four observers on a 1 to 10 basis with 10 being a perfect plot. Estimates of relative uniformity were based on plant to plant variation within individual plots using measurements of the cured tobacco. Yield per acre, price per hundredweight and acre values were also determined.

Results

The field results are presented in Table 1 and indicate that under the conditions of ideal soil moisture at time of transplanting there were no significant differences between any of the treatments for yield, price or acre value. Thus under optimum moisture conditions the cube transplant method is equal to the conventional system of transplanting by these agronomic parameters. Therefore if an economic advantage can be shown for the cube system, it could be adopted for grower use.

The measurements for uniformity show some improvement for both the cube and the specially selected plant. This was true for treatments with water at time of transplanting and where no water was used.

Summary

The peat-soil cube performed satisfactorily under these conditions of optimum soil moisture. This method would be suitable for general farm use if it proves economically feasible. The cube resulted in increased plant uniformity in early growth at 3-weeks after transplanting and in the cured plant when compared to the control.

Table 1. Yield, price, acre value, uniformity and early growth rating of various types of tobacco transplants, 1971.

Treatment	Yield lbs/A	Price $/cwt.	Value $/A	Estimates of relative uniformity *	Rating of early growth
(with water)					
Control	2352	77.73	1829	100	6.63
Peat-soil cube	2273	76.16	1732	321	7.41
Selected plant	2376	75.48	1795	172	8.38
(without water)					
Control	2351	76.59	1800	118	5.13
Peat-soil cube	2167	78.26	1697	148	5.94
Selected plant	2288	76.43	1750	164	7.13
L.S.D.	N.S.	N.S.	N.S.		
C.V.	6.8%	1.6%	7.9%		

* The control treatment was arbitrarily set at 100. The larger the estimate of relative uniformity the greater the uniformity.

The Use of 2-Chloroethylphosphonic Acid (CEPA) to Improve Maturity of Maryland Tobacco

J. H. Hoyert
Department of Agronomy

Purpose and Objectives

There is need for work on reducing the range of maturities between the lower and upper leaves of the tobacco plant at harvest time. Maryland tobacco is stalk-cut at that critical time when the middle leaves are of optimum ripeness, the lower leaves are overmature and the top leaves are immature. This wide range is a limiting factor to new procedures of harvesting and curing being developed for labor reduction. The chemical growth regulator 2-chloroethylphosphonic acid had shown some promise in previous observations of improving maturity. It was thought that further work was desirable with this material. This chemical will be listed herein as CEPA but had been known as ethrel and is now labeled as ethephon.

The objective of this study was to compare the effect of maturity at time of application upon the yield, price and acre values of cured tobacco when treated with CEPA.

Procedure

This preliminary study was located on a Monmouth sandy loam soil at the Tobacco Experimental Farm. Md. 609 variety was planted at a population of 6,223 plants per acre with 60-120-180 lbs. of fertilizer broadcast per acre. An additional 30 lbs. of N was sidedressed 3 weeks after planting to compensate for early high rainfall. The design was a randomized complete block with four replicates. Plots were planted on June 10, 1971 and topped on August 6, 1971.

CEPA was applied at the rate of 75 mg per plant. Treatments were as follows:

Treatment	Time of Application	Time of Harvest
1	Aug. 6, 1971	Aug. 11, 1971
2	Aug. 11, 1971	Aug. 16, 1971
3	Aug. 16, 1971	Aug. 20, 1971
4	Aug. 20, 1971	Aug. 26, 1971
5	Aug. 26, 1971	Aug. 30, 1971
6	Aug. 31, 1971	Sept. 4, 1971

The chemical was added to water to bring total volume up to 20 ml per plant and sprayed in a fine mist over the entire plant. The test was designed to be harvested 4 to 6 days after treatment with CEPA. The variation in time of application was to determine the effect of maturity of the plant upon response to CEPA.

Results

Table 1 presents the yield, price and acre values of tobacco in 1971. Yield, price and acre values were decreased at the August 11th and the September 4th harvest dates. The early date of August 11th resulted in small immature leaves in the upper part of the plant. The late date of September 4th gave mature top leaves but there was a loss because of "firing" of bottom leaves and a deterioration in quality of those grades from the lower part of the plant. The CEPA caused the top leaves from treatments 3, 4, 5 and 6 to turn a "ripe" yellow color by the time of harvest. Treatments 1 and 2 did not result in "ripe" or yellow upper leaves when harvested. Tobacco from treatments 3 through 6 turned into a bright, clear yellow color which was uniform over the whole plant within 3 days after hanging in the curing barn.

Summary

The application of 75 mg per plant of CEPA caused a yellowing of the treated leaves of mature plants. The immature plants of treatments 1 and 2 did not yellow as a result of CEPA applications. CEPA treated tobacco "yellowed-down" uniformly and completely within 3 days in the curing barns. Yield, price and acre values were lower for the early (August 11th) and late (September 4th) harvest dates.

Table 1. Effect of CEPA on yield, price and acre values of Maryland tobacco. 1971.

Treatment	Time of Application	Time of Harvest	Yield lbs/A	Price $/cwt.	Value $/A
1	August 6	August 11	1914	75.91	1451
2	August 11	August 16	2231	78.17	1744
3	August 16	August 20	2285	79.01	1805
4	August 20	August 26	2075	79.38	1653
5	August 26	August 30	2436	79.20	1929
6	August 31	September 3	2008	77.60	1557
L.S.D.	(.05)		194	1.81	133
	(.01)		269	2.50	184
C.V.			6.0%	1.5%	5.2%

Chemical Topping Studies

C. G. McKee
Department of Agronomy

Purpose and Objectives

To investigate the potential of chemicals for topping Maryland tobacco. Contact-type chemicals have long been used for sucker control in the tobacco area. If a contact acting chemical can be satisfactorily used to kill the flower bud, it would save one operation that is now carried out by hand.

Procedure

The chemical-topping studies were set up with four treatments: chemical topping using 1-decanol, bud topping, early bloom topping and early bloom topping with chemical sucker control using T-148. Md. 609 variety was used for this test.

Results

Results for chemical topping are summarized in Table 1. The chemical topping treatment resulted in the highest yield and gross dollar return. It also had satisfactory quality as indicated by the price/lb. and a low level of alkaloids -- also a desirable trait. Bud topping was the least desirable treatment this year. It resulted in the lowest yield and dollar return. There was an approximate 200 pound increase in yield per acre when the contact sucker control chemical T-148 was used compared with the normal topping treatment. The normal topping treatment, where the suckers are allowed to grow, also resulted in the highest alkaloid content.

Summary

The results from the chemical topping study indicate that 1-decanol can be satisfactorily used to kill the terminal bud and thus "top" tobacco. This chemical also gives sucker control. Thus, one application can be used to both top and control suckers. 1-decanol received an experimental label for use on the 1971 tobacco crop. The major problem with this chemical is the necessity for very precise application. Until such equipment is designed it will have to be applied by hand sprayers.

Table 1. Effect of Chemical Topping on performance of Maryland tobacco, 1971.

	Treatment	Yield lbs/acre	Price/lb. cents	$/Acre	% Total Alkaloids
1.	Chemical topped	2427	76.1	1848	1.02
2.	Bud topped	1908	76.1	1449	0.93
3.	Early bloom topping (normal)	2210	76.8	1694	1.70
4.	Early bloom topping + T-148	2416	75.6	1827	1.26

Irrigation with Maryland Tobacco

C. G. McKee
Department of Agronomy

Purpose and Objectives

Previous research has indicated that the investment in irrigation equipment can be justified on most tobacco producing farms in Southern Maryland. The number of acres of tobacco that is presently irrigated is still relatively small -- about 15% of the total, but it is increasing every year. Previous work also indicated that some varieties respond differently than others to higher nitrogen levels when adequate moisture is available.

The objective of this research is to determine the differential response of the released Maryland varieties and advanced breeding lines to nitrogen levels under optimum soil moisture conditions.

Procedures

The experiment was a split-split-plot design. Main plots were irrigation vs. no irrigation. The first split was nitrogen rate -- 70 and 100 pounds per acre and the second split was variety -- Md. 10, Md. 609, Md. 64 and breeding lines 872, 231 and 37F. There were four replicates for a total of 96 plots.

The experiment was located at the University of Maryland Tobacco Experimental Farm. The soil was Monmouth fine sandy loam. The initial fertilizer application of 60 lbs. nitrogen, 120 lbs. P_2O_5 and 180 lbs. K_2O was broadcast and disked in prior to planting. The additional nitrogen necessary was applied as a sidedressing 2 weeks after transplanting.

Water was applied to the plots requiring irrigation when the plants were starting to show slight wilting in the heat of the day. A Skinner irrigation system was used that applied approximately 1/4 inch of water per hour.

Results

The 1971 growing season was generally good for Maryland tobacco. One inch of water was applied to the irrigated treatments on July 15 and 16 and again on July 29.

The results for 1971 are in Table 1. The irrigated tobacco yielded about 100 pounds per acre less than that which was not irrigated, however it sold for 1/2 cent more per pound than the non-irrigated. This resulted in the irrigated tobacco returning $19 less per acre than the non-irrigated. There was no overall response to increased nitrogen in 1971. There was a slight increase in yield and quality from additional nitrogen with irrigation but a decrease without irrigation. Variety differences were consistent with those normally observed with Md. 10, the lowest dollar return per acre, and Md. 64, the highest. Breeding line 872 was the second highest in yield per acre with the second highest $/cwt. These breeding lines will be continued in the test for another year.

Summary

Irrigation tests have to be conducted over a number of years to get meaningful results. This study will be continued.

Table 1. Summary of the Irrigation Test with Tobacco -- 1971.

Yield -- Pounds/Acre

Variety	Irrigated		Non-Irrigated	
	Low N	High N	Low N	High N
Md. 10	1827	1849	2053	2029
Md. 609	1967	2103	2141	2060
Md. 64	2360	2409	2650	2478
BL 872	2212	2419	2371	2313
BL 231	2078	2140	2211	2168
BL 37F	2038	2084	2167	2083
Average	2080	2167	2265	2188

Average Price/Pound -- Cents

Variety	Irrigated		Non-Irrigated	
	Low N	High N	Low N	High N
Md. 10	74.8	74.6	76.0	74.0
Md. 609	76.3	78.2	77.5	78.3
Md. 64	74.2	74.5	75.3	71.8
BL 872	77.5	78.1	76.1	75.2
BL 231	76.7	75.5	75.0	74.9
BL 37F	76.1	75.7	76.5	76.8
Average	75.9	76.1	76.1	75.0

Table 1. Continued

Dollars/Acre

Variety	Irrigated		Non-Irrigated	
	Low N	High N	Low N	High N
Md. 10	1386	1380	1540	1501
Md. 609	1484	1646	1678	1623
Md. 64	1895	1797	1846	1775
BL 872	1791	1890	1732	1738
BL 231	1594	1614	1665	1624
BL 37F	1623	1577	1587	1600
Average	1629	1651	1675	1643

	Yield	Cents/Pound	$/Acre
Irrigation			
Irrigated	2124	76.0	1640
Non-Irrigated	2227	75.5	1659
Nitrogen			
Low N	2173	76.0	1652
High N	2178	75.5	1642
Variety			
Md. 10	1939	74.8	1452
Md. 609	2068	77.5	1608
Md. 64	2474	73.7	1828
BL 872	2329	76.7	1788
BL 231	2149	75.5	1624
BL 37F	2093	76.3	1596

Effects of MH-30 and Antitranspirant Spray on Regulating Air Pollution Damage to Maryland Tobacco

C. L. Mulchi
Department of Agronomy

Purpose and Objectives

Two major factors which have been associated with regulating a plant's susceptibility to air pollution are: (1) physiological activity of leaves approaching maturity and (2) the permeability of leaves to pollutant gasses. In recent years many agents which influence these factors in plants have been tested in greenhouse and field studies to determine their influence on regulating the susceptibility of plant leaves to pollutant damage.

The compound MH-30 has been used extensively and very successfully in the tobacco industry to control the growth of suckers (axillary buds). Its primary mode of action is to suppress cell division yet permit cell elongation to continue. However, it also changes other physiological activities in leaves. It is a systemic material that is sprayed on the younger actively growing leaves and then translocated to other parts of the plant.

The regulation of leaf permeability by agents such as antitranspirants has received only limited success in certain crops. Its primary mode of action is to block stomata thus slowing the loss of water from leaves. The manufacturers of a common such material "Vapor Gard" (Miller Chemical and Fertilizer Corp., Hanover, Penn.) advertised the material as being effective in protecting plant leaves from air pollution damage. Due to the increasing damage to Maryland tobacco from air pollution, such a material would have potential for usage if proven effective in reducing damage, etc.

Of interest in this study was determining (1) the effectiveness of MH-30 and antitranspirant sprays on reducing damage by air pollution on Maryland tobacco and (2) possible effects these materials have on agronomic and chemical properties of the tobacco.

Procedures

In 1971, a field experiment was conducted at the Tobacco Experiment Station, Upper Marlboro, Maryland using both MH-30 and VG (Vapor Gard) in an effort to reduce vegetation damage by air pollution. Tobacco variety Md. 59 was selected due to its high susceptibility to air pollution damage (weather fleck). The field plan consisted of a randomized complete block design with six treatments and four replications. Each plot contained two rows with seventeen plants per row. Border rows separated each plot to prevent drift contamination during application of materials. One of the plot rows was for harvest and the other for sampling. Treatments imposed were: (1) control, (2) MH-30 applied at topping, (3) MH-30 and VG applied at topping - i.e. MH-30 applied to upper one-third and VG applied to middle and lower portions of the plant, (4) VG applied at four weeks prior to topping -- i.e. entire plant sprayed, (5) VG applied two weeks prior to topping, and (6) VG applied to plants at topping. MH-30 was applied at the recommended rate of one pint per 1000 plants. VG was applied at a concentration of 2% in water at a rate of 25 ml of solution per plant. Both materials were applied with a low pressure hand sprayer.

Leaf samples were taken from the lower one-third of the plants in selected plots on the days when treatments were applied and at the time of scoring and harvest. The samples were washed, freeze-dried and ground.

Just prior to harvest, the plants were scored for pollution damage in the following manner: individual leaves of plants (plant Nos. 1, 4, 7, 10, 13 and 16) in the harvest rows were scored visually for damage on a scale of 0 to 5 with 0 = no damage and 5 = severe damage. Following scoring, fifteen plants were harvested, placed on sticks and cured in the normal manner. Following curing the tobacco was processed for sale in the normal manner and yield, price per cwt. and acre values were determined.

Results

Table 1 contains a summary of treatment effects relating to air pollution damage and agronomic and chemical properties of the tobacco. In general there were no significant changes in the relative susceptibilities of the plants in the various treatments to air pollution damage. All treatments had an average of about 11.1 leaves damaged per plant with an average rating of 2.52 per leaf showing damage. The damage was generally confined to the lower two-thirds of the plant.

Two possible explanations for the failure of the antitranspirant spray to retard damage are (1) inadequate coverage of the leaves, particularly on the undersurfaces, by the materials and (2) the possible removal or breakdown of the material on the upper surface by natural elements such as rain and sunlight. The low pressure equipment used in the study perhaps failed to effectively apply the materials to all leaf surfaces uniformly. Also, a common problem with antitranspirant sprays is that the materials are generally effective for a short time and repeated applications are necessary due to their removal and breakdown.

The failure of the antitranspirant spray to effectively retard air pollution damage in this study should not be taken as sufficient reason to reject the use of this product. Further work with different methods of application and timing the applications to immediately precede smog inversion periods should be investigated. This could lead to a practical method for reducing pollution damage to tobacco.

The failure of MH-30 to reduce the degree of damage by air pollution was most probably due to the fact that many of the lower leaves had reached maturity at the time of application. Many of these leaves were showing damage at the time of application. It was anticipated that these treatments would result in fewer leaves per plant being damaged. Perhaps the direct

application of this material to the older, more mature leaves would alter the physiology of these leaves to reduce air pollution damage. This would result in greater quantities of the material reaching the tissue most subject to damage.

The treatments had no significant effects on the agronomic properties such as yield, average price and value. The extensive damage by the pollutants most probably masked out differences that may have occurred. This same explanation probably holds true for the lack of differences in the total alkaloid and total nitrogen level in the tobacco in the various treatments.

Summary

A field experiment to study the effects of MH-30 and an antitranspirant spray on regulating the susceptibility of Maryland tobacco to air pollution damage was conducted in 1971. No significant treatment effects were observed in either the vegetation damage or in the data obtained on agronomic and chemical properties of the tobacco. Possible explanations for the failure of MH-30, a growth regulator, to alter the plant's susceptibility are (1) the material was applied to the upper leaves which generally are not affected by air pollution since they are immature and (2) the lower leaves were showing some damage at the time of application -- i.e. at plant maturity.

Failure of the antitranspirant spray to alter air pollution damage can most probably be attributed to the lack of effective coverage of the leaf surfaces caused by the low pressure equipment and (2) possible removal and breakdown of the material by natural elements. Further research on methods of application and timing of application prior to smog inversion periods should be conducted.

Table 1. Effects of MH-30 and antitranspirant sprays on air pollution damage and agronomic properties of Maryland tobacco (Md. 59).

Treatment [a]	Damaged Leaves per plant	Rating [b] per damaged leaf	Yield lbs/A	Price $/100 lb.	Value $/A	Total [c] Alkaloids %	Total [c] Nitrogen %
1	10.6	2.65	1233	74.97	925	1.73	2.11
2	11.1	2.37	1086	74.93	814	1.74	2.09
3	11.3	2.42	1157	74.95	868	1.80	2.23
4	11.4	2.62	1081	75.30	815	1.85	2.12
5	11.8	2.48	1137	73.90	841	1.75	1.98
6	10.7	2.60	1148	75.23	864	1.91	2.40
Mean	11.1	2.52	1140	74.88	854	1.79	2.15
L.S.D. (.05)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

[a] Treatments: (1) control, (2) MH-30 at topping, (3) MH-30 plus antitranspirant spray at topping, (4) antitranspirant spray four weeks prior to topping, (5) antitranspirant spray 2 weeks prior to topping, and (6) antitranspirant spray at topping.

[b] Scale of 0 to 5 with 0 = no damage and 5 = severe damage.

[c] Green leaf samples were taken from lower one-third of the plant at time of scoring just prior to harvest.

Genetic Regulation of the Susceptibility of Maryland Tobacco Varieties to Air Pollution

Rosanna T. S. Hsieh, C. L. Mulchi and M. K. Aycock, Jr.
Department of Agronomy

Purpose and Objectives

It has been recognized in recent years that varieties of Maryland tobacco differ significantly in their response to exposure to air pollution. Field studies by Aycock have demonstrated through crosses of Maryland type with cigar type tobacco that progress could be made through selection for greater resistance to air pollution.

Genetics is not the only factor regulating plant response to air pollution. Many environmental factors such as moisture, light, nutrition and mixtures of atmospheric gases are important. The current study was designed to grow plants under more controlled conditions than exist in the field and to expose all plants to the same concentrations of air pollution under conditions of controlled light, moisture, nutrition and stage of growth. Thus, the genetic effects would be enhanced and more clearly defined.

Procedures

In order to obtain a broad genetic base, seven varieties of Maryland tobacco were used. Their sensitivities to ozone ranged from moderately resistant to highly susceptible. All possible crosses, excluding reciprocals, were made among the seven parents giving a total of twenty-one hybrids and seven parents as entries in the study. Bel-W3, a highly sensitive cigar type, was also included as an indicator. The experiment was conducted in the greenhouse between April and October, 1971, with several groups of plants containing all the various entries being grown during the period. The plants were watered daily and fertilized uniformly with 7-7-7 analysis fertilizer as

needed. Plants to be exposed to ozone were selected very carefully on the basis of their stage of growth, color, vigor, etc. and those not meeting the standards for uniformity were discarded or used for other purposes.

The capacity of the fumigation chamber was about forty plants. The normal procedure was to select about thirty-eight plants from the various entries and to place them randomly in the chamber along with about two Bel-W3 plants. Generally the thirty-eight plants would be comprised of five or six plants each from six or seven entries. Throughout the study a total of 160 plants of each parent variety and 80 plants from each hybrid entry were exposed. For statistical purposes, the 160 and 80 plants were grouped into 4 and 2 replications, respectively, with 40 plants per replication. Each replication roughly conformed to a six-week period, thus variation in greenhouse conditions and light lengths, etc. would be removed in the replications.

Air entering the chamber was filtered through activated charcoal. The ozone was generated from pure oxygen and injected continuously into the system. The plants were exposed for four hours at 0.5 $\pm$ 0.01 ppm ozone. The temperature was regulated at 80 $\pm$ 2° F, the relative humidity remained at 80 $\pm$ 5% and the light intensity equaled about 1000 ft-c in the chamber. The ozone levels were monitored continuously with a Mast Ozone Meter (Model 724-2). After exposure, the plants were returned to the greenhouse bench.

Vegetation damage was normally apparent at the time the plants were removed from the chamber but the symptoms became more pronounced with time. On the third day following fumigation, the damaged leaves were removed from the plants and frozen for scoring at a later time. For scoring, the thawed leaves were placed on a light table and the damaged area was determined using a plastic overlay with a 1/10-inch grid. The leaves were refrozen, freeze-dried, ground and sealed in bottles for later analysis. At this time, only total nitrogen analyses has been completed.

Total leaf area was calculated using Equation (1) where L = leaf length, W = maximum leaf width and C = constant for the particular variety or hybrid involved. The constants (C) were determined for each entry by placing fresh, nonfumigated leaves of each entry on photographic paper and briefly exposing to bright light. The nonexposed area, which represented the area of the leaves, was determined by comparing the weight of the paper leaves to weight of similar paper with known areas. After measuring the lengths and widths of the paper leaves and calculating their areas, the constants are calculated using Equation (1). Each entry had a unique constant based on its particular leaf shape.

$$\text{Area} = (L \times W)\, C \qquad (1)$$

Results

The data in Table 1 summarizes the information obtained thus far from the greenhouse study. The data has to be subjected to statistical analysis and appropriate genetic parameters are apt to be determined from the data. However, due to the large numbers of plants involved for each entry, very meaningful inferences can be made from the averages shown in Table 1.

In general, the responses of the seven parent varieties appear very consistent with what has been observed in field studies and reported by Aycock. Wilson variety has the greatest resistance as indicated by the lowest index rating of all the entries. Catterton and Md. 59 have the lowest resistance to air pollution of the established varieties included in the study. It is of interest that the Catterton x Md. 59 hybrid has a greater susceptibility to air pollution than either parent. In general, the crosses involving Md. 59 have very high susceptibility to ozone damage, even if the other parent has high resistance such as Wilson or Md. 609.

There appears to be a poor correlation between the number of leaves damaged per plant and the percent area of leaves damaged or index. Apparently

from three to six leaves per plant were susceptible to pollution damage at the time of exposure with Bel-W3 being an exception. It is of interest that there appears to be a greater number of leaves per plant damaged in the hybrids than the parent varieties.

The total nitrogen levels are somewhat variable but generally average between 3.5 and 4.0 percent. Levels this high are consistent with levels found in the field for plants of comparable age. There appears to be a poor correlation between total nitrogen levels and the index for damage. In other studies, nitrogen levels have been found to greatly influence plant susceptibility particularly when in excessive abundance and when plants are showing nitrogen deficiency. The levels found in this study appear to fall intermediate in concentration thus were not critical factors.

Summary

This report summarizes a greenhouse study in which seven Maryland tobacco varieties and twenty-one hybrids were exposed to 0.5 ppm ozone for four hours. Data from the parent varieties are consistent with field observations where plants were exposed to natural levels of air pollution. In general, the hybrids were intermediate in susceptibility to their respective parents. Hybrids with Md. 59 as one parent generally are highly susceptible to air pollution, even when the other parent was relatively low in susceptibility such as Wilson. A complete statistical and genetical analysis of the data is incomplete at this time.

Table 1. Data from greenhouse study involving the exposure of Maryland tobacco varieties and hybrids to 0.5 ppm ozone for four hours. 1971.

Entry	Leaves Damaged per plant	Percent[a] Area of Leaves Damaged	Index[b]	Total Nitrogen Levels %	Leaf[c] Area Constants
Catterton	4.44	10.43	4.84	3.62	0.6463
Wilson	3.56	3.95	1.83	4.08	0.6642
Gertz	3.58	4.73	2.19	3.25	0.6533
Md. 59	4.62	10.60	4.92	3.37	0.6401
Md. 609	5.13	5.56	2.58	3.59	0.6637
Md. 64	3.76	5.15	2.39	3.80	0.6530
Md. 10	3.44	6.53	3.03	2.58	0.6530
Cat. x Wil.	4.82	5.36	2.49	3.84	0.6598
Cat. x Gertz	5.47	6.64	3.08	4.17	0.6609
Cat. x Md. 59	5.36	13.02	6.05	4.99	0.6618
Cat. x Md. 609	5.87	10.66	4.95	3.62	0.6627
Cat. x Md. 64	5.17	7.73	3.59	4.30	0.6593
Cat. x Md. 10	4.71	7.22	3.36	4.04	0.6554
Wil. x Gertz	4.37	4.57	2.12	3.34	0.6348
Wil. x Md. 59	5.24	9.00	4.18	3.29	0.6414
Wil. x Md. 609	5.75	6.90	3.20	3.34	0.6414
Wil. x Md. 64	5.00	4.43	2.06	4.33	0.6642
Wil. x Md. 10	4.62	4.57	2.12	4.03	0.6603
Gertz x Md. 59	5.84	11.65	5.41	3.00	0.6436
Gertz x Md. 609	6.04	10.62	4.93	4.09	0.6425
Gertz x Md. 64	5.44	6.15	2.86	4.42	0.6567
Gertz x Md. 10	5.08	6.18	2.87	4.20	0.6359
Md. 59 x Md. 609	5.71	15.94	7.41	4.06	0.6460
Md. 59 x Md. 64	5.43	9.42	4.38	3.83	0.6464
Md. 59 x Md. 10	5.36	11.99	5.57	3.32	0.6552
Md. 609 x Md. 64	6.10	5.17	2.40	3.89	0.6303
Md. 609 x Md. 10	5.85	7.63	3.54	4.39	0.6538
Md. 64 x Md. 10	5.57	5.31	2.47	4.42	0.6588
Bel-W3	7.58	21.52	10.00	4.27	0.6744

[a] Based on leaves showing damage, not total leaf area on plant.

[b] Based on Bel-W3 percent leaf area damage = 10.

[c] Determined for each entry to calculate leaf area (Area = (L x W) C).

Foxtail and Fall Panicum Control in No-Tillage Corn

J. V. Parochetti
Department of Agronomy

Purpose and Objectives

Fall panicum and foxtail are two commonly occurring weeds in no-tillage corn production. There are several herbicides in conventional tillage which might be utilized in no-tillage.

The objective of this experiment was to evaluate several residual herbicides and combinations for foxtail and fall panicum control in no-tillage corn.

Procedures

The experimental site, heavily infested with fall panicum and foxtail, was located at the Plant Research Farm, Fairland, Maryland. A rye cover crop was planted in the fall of 1970.

All herbicides were applied May 5, 1971 as tank mixtures at 30 gpa with an experimental bicycle sprayer. Pioneer 3369A was planted May 4. Plots were 4 rows with rows spaced at 2.5 feet; individual plots were 10 by 30 feet. The experimental design was a randomized complete block with 4 replications.

The European rating system (Table 1) was used for crop and weed control ratings.

Results

All herbicides resulted in excellent giant green foxtail control. Only herbicide combinations containing simazine resulted in excellent fall panicum control. Cyanazine (Bladex) plus paraquat resulted in about 90% fall panicum control when observed on October 12, 1971, but this degree of control was significantly less than from simazine. Other

herbicides, such as atrazine, alachlor or combinations, resulted in poor (less than 85%) panicum control.

In no-tillage plots, corn yields were highest with herbicide combinations containing simazine.

Summary

Only herbicide combinations containing simazine resulted in excellent fall panicum control and subsequently highest corn yields.

Table 1. Rating system for evaluating weed response and crop injury utilized in these investigations.

Rating Number	% Weed Control	Remarks	% Crop Injury	Remarks
1	100.0	Completely destroyed	0	No injury
2	97.5	Very good control	2.5	May be injured
3	95.0	Good control	5.0	Injured slightly
4	90.0	Satisfactory	10.0	Injured, but satisfactory
5	85.0	Just satisfactory	15.0	Injured, barely satisfactory
6	75.0	Unsatisfactory	25.0	Not satisfactory
7	65.0	Poor	32.5	Injured, bad
8	32.5	Very poor	65.0	Injured, very bad
9	0	As untreated	100.0	Completely destroyed

Table 2. Weed control and corn yields in no-tillage corn. Plant Research Farm, Fairland, Maryland, 1971.

	Treatment[a]	lb/A actual ingredient	July 29, 1971 Giant Green Foxtail	July 29, 1971 Fall Panicum	October 12, 1971 Giant Green Foxtail	October 12, 1971 Fall Panicum	October 18, 1971 Corn Bu/A
1.	Plow and disk	0	9.0	9.0	9.0	8.75	4.2
2.	Plow and disk						
	Atrazine (AAtrex)	2 pre	1.25	6.75	1.0	7.25	67.0
3.	Cover removed + Paraquat	¼ pre					
	+ Atrazine	2 pre	1.0	6.75	1.0	6.5	27.6
4.	Paraquat +	¼ FAR[b]					
	Atrazine	2 pre	1.0	5.75	1.0	7.25	38.7
5.	Paraquat	¼ FAR	1.0	7.25	1.25	8.25	9.3
6.	Paraquat +	¼ FAR					
	Alachlor (Lasso) +	1.5 pre	1.0	6.0	1.0	6.25	49.6
	Atrazine	1.5 pre					
7.	Paraquat	½ FAR	1.0	7.25	1.5	8.0	12.5
8.	Paraquat +	¼ FAR					
	Simazine (Princep)	2 pre	1.0	1.25	1.0	1.25	65.1
9.	Paraquat +	¼ FAR					
	Atrazine +	1.0 pre	1.0	2.50	1.0	1.25	70.6
	Simazine	1.0 pre					
10.	Paraquat +	½ FAR					
	Atrazine +	2.0 pre	1.0	1.25	1.0	1.25	74.9
	Simazine	2.0 pre					
11.	Atrazine + Simazine	2 + 2 pre	1.0	2.0	1.0	2.5	67.3
12.	Paraquat +	¼ FAR					
	Cyanazine (Bladex)	2 pre	1.0	4.25	1.0	3.75	44.5
13.	Paraquat +	¼ FAR					
	Alachlor +	2.25 pre	1.0	4.50	1.0	5.25	50.2
	Atrazine	1.5 pre					
		lsd 0.05 =	.20	1.46	.45	1.59	21.9
		lsd 0.01 =	.27	1.97	.61	2.14	29.5

[a] Treatments 3 through 13 not plowed.

[b] FAR = Foliar applied to rye.

Glyphosate - A New Herbicide for Johnsongrass Control

J. V. Parochetti
Department of Agronomy

Purpose and Objectives

Johnsongrass is a serious perennial weed. At present, there are a limited number of herbicides which are effective on johnsongrass. The purpose of this experiment was to evaluate glyphosate compared to dalapon as a preplow foliar treatment for johnsongrass control under field conditions.

Procedures

Three sites were used for evaluating glyphosate for johnsongrass control. At all sites, herbicides were applied to actively growing johnsongrass with 1% surfactant at 30 gpa with an experimental bicycle sprayer.

Site 1 was at the Poplar Hill Research Farm, Quantico Road, Salisbury, Maryland. The soil was an Evesboro loamy sand. Johnsongrass was 18 to 24 inches tall when treated on June 10, 1971. Some plots were plowed within 1 hour of treatment while others were plowed 12 days later (see Table 1 for treatments). On June 23, trifluralin (0.5 lb/A) was incorporated with a disk set to cut about 6 inches deep and soybeans planted. Plots were cultivated once 5 weeks after planting. The experimental design was a randomized complete block with 2 replications. Plot size was 10 by 20 feet with 2.5 foot row spacings.

Site 2 was in Mechanicsville, St. Mary's County, Maryland. The soil was a sandy loam. Johnsongrass was 18 inches tall having been previously clipped when herbicides were applied September 2 (see Table 2 for treatments). The experimental design was a randomized complete

block with 4 replications. Plots were 10 by 20 feet. No crop was planted.

Site 3 was in Stillpond, Kent County, Maryland. The soil was a silt loam. Johnsongrass was 24 to 36 inches tall having been previously clipped when sprayed on September 16. The experimental design was a randomized complete block with 3 replications; plot size was 10 by 20 feet. No crop was planted.

Results

Site 1. Visual johnsongrass control ratings were taken; in addition, johnsongrass between 2 rows (50 sq. ft.) was harvested (Table 1). The visual control ratings were higher than the percentage control based on fresh weight of johnsongrass. Johnsongrass control resulting from 1.0 and 2.0 lb/A glyphosate was not significantly different (fresh weight basis). Johnsongrass control was, however, better at 2 lb/A glyphosate than 5 lb/A dalapon. Johnsongrass control was the same for 1 lb/A of glyphosate and 5 lb/A dalapon. No soil activity was noted when soybeans were planted.

Site 2. All rates of glyphosate resulted in significantly better johnsongrass rhizome kill (visually estimated) than dalapon at 5 lb/A (Table 2). Plowing alone caused a significant increase in rhizome johnsongrass control compared to the unplowed check. However, plowing 20 days after foliar treatment with dalapon or glyphosate did not enhance rhizome kill.

Site 3. At this location the amount of necrosis resulting from 2.0 and 2.5 lb/A glyphosate was significantly greater than that from dalapon (5 lb/A) and glyphosate at 0.5 and 1 lb/A. The percent rhizome kill was similar from all rates of glyphosate above 1 lb/A and dalapon

at 5 lb/A. Plowing did not enhance rhizome kill at this date of observation.

Summary

Glyphosate resulted in johnsongrass rhizome kill when applied to foliage of johnsongrass. In one of the three studies reported, glyphosate (1 to 2.5 lb/A) was more effective than dalapon (5 lb/A). Glyphosate treated johnsongrass, which was plowed in 0.5 hours, was not effectively kill; however, waiting 12 days after foliar glyphosate treatments resulted in significantly greater johnsongrass control.

Table 1. A field study of glyphosate and dalapon applied preplow to foliage of johnsongrass.

Treatment	Rate lb/A	Time Plowed After Treatment	% Control (top growth) Visual Ratings 7/16/71	Visual Ratings 8/20/71	Fresh wt basis 9/9/71
1. Control	----	0.5 hr	0 c[a/]	0 d	0 c
2. Glyphosate	1.0	0.5 hr	15 bc	0 d	29 bc
3. Glyphosate	2.0	0.5 hr	50 b	50 c	34 b
4. Control	----	12 days	0 c	0 d	0 bc
5. Glyphosate	1.0	12 days	90 a	90 b	67 a
6. Glyphosate	2.0	12 days	95 a	98 a	89 a
7. Dalapon	5.0	12 days	92 a	90 b	71 a

[a/] Data in the same columns followed by the same letter are not statistically different at the 5% level of probability according to Duncan's Multiple Range Test.

Table 2. A field study with glyphosate and dalapon for johnsongrass control in St. Mary's County.

	Treatments (9/2/71)	Rate lb/A	% Necrosis 10/5/71	% Rhizome Kill 10/5/71
1.	Control	----	5.0 a[b/]	7.5 a
2.	Glyphosate	1.5	95.8 c	72.5 d
3.	Glyphosate	2.0	96.5 c	85.0 d
4.	Glyphosate	2.5	97.0 c	86.3 d
5.	Dalapon	5.0	71.8 b	52.5 c
6.	Control - plowed[a/]	----	------	32.5 b
7.	Glyphosate - plowed	1.5	------	85.0 d
8.	Glyphosate - plowed	2.0	------	90.0 d
9.	Glyphosate - plowed	2.5	------	86.3 d
10.	Dalapon - plowed	5.0	------	53.8 c

a/ Johnsongrass about 18 inches tall when plowed on September 14, 1971.

b/ Data in the same columns followed by the same letter are not statistically different at the 5% level of probability according to Duncan's Multiple Range Test.

Table 3. A field study with glyphosate and dalapon for johnsongrass control in Kent County.

	Treatments[a/] (9/16/71)	Rate lb/A	% Necrosis 10/5/71	% Rhizome Kill 10/5/71
1.	Control	----	3.3 a[b/]	26.7 a
2.	Glyphosate	.5	66.7 c	45.0 ab
3.	Glyphosate	1.0	76.7 cd	65.0 bcd
4.	Glyphosate	1.5	86.7 de	51.7 bcd
5.	Glyphosate	2.0	94.3 e	65.0 bcd
6.	Glyphosate	2.5	98.7 e	63.3 bcd
7.	Dalapon	5.0	50.0 b	46.7 abc
8.	Control	----	------	46.7 abc
9.	Glyphosate	.5	------	50.0 bcd
10.	Glyphosate	1.0	------	70.0 cd
11.	Glyphosate	1.5	------	48.3 a-d
12.	Glyphosate	2.0	------	71.7 d
13.	Glyphosate	2.5	------	70.0 cd
14.	Dalapon	5.0	------	53.3 bcd

a/ Johnsongrass was about 30 inches tall; treatments 8 through 14 were plowed September 30, 1971.

b/ Data in the same column followed by the same letter are not statistically different at the 5% level of probability according to Duncan's Multiple Range Test.

Herbicides for No-Tillage Double Cropped Soybeans

J. V. Parochetti
Department of Agronomy

Purpose and Objectives

Successful weed control in no-tillage double cropped soybeans is paramount for top yields. Weeds that are present following small grain harvest must be killed and subsequently germinating weeds must also be controlled. Paraquat is used to kill existing weeds after small grain harvest and a residual herbicide (such as linuron) is also applied to control later germinating weeds. Many growers know linuron has postemergence herbicidal activity. Therefore, one purpose was to investigate the potential of linuron alone and with surfactants for the killing of weeds present after small grain harvest for no-tillage soybean production. Another purpose was to evaluate several residual herbicides with paraquat for annual weed control.

Procedures

Two experiments were conducted in 1971 at the Poplar Hill Research Farm, Quantico Road, Salisbury, Maryland. The soil of the two adjacent experiments was a Bertie silt loam with about 1.5% organic matter. The experimental designs were randomized complete blocks with 4 replications. Row spacing was 20 inches. Following small grain harvest, herbicide treatments were applied on June 23, 1971.

The European rating system (Table 1) was used for crop and weed control ratings.

Table 1. Rating system for evaluating weed response and crop injury utilized in these investigations.

Rating Number	% Weed Control	Remarks	% Crop Injury	Remarks
1	100.0	Completely destroyed	0	No injury
2	97.5	Very good control	2.5	May be injured
3	95.0	Good control	5.0	Injured slightly
4	90.0	Satisfactory	10.0	Injured, but satisfactory
5	85.0	Just satisfactory	15.0	Injured, barely satisfactory
6	75.0	Unsatisfactory	25.0	Not satisfactory
7	65.0	Poor	32.5	Injured, bad
8	32.5	Very poor	65.0	Injured, very bad
9	0	As untreated	100.0	Completely destroyed

The two experiments were labeled A and B and treatments were as follows:

Experiment A. Herbicide treatments were applied at 34 gpa with a tractor-pulled Clark sprayer; plot size was 15 by 60 feet.

Experiment B. Herbicide treatments were applied at 30 gpa with an experimental bicycle sprayer; plot size was 10 by 20 feet.

Results

Experiment A. Paraquat, 0.5 lb/A, was necessary for the control of weeds that were present after barley harvest (Table 1A). Weeds that were present were marestail and ragweed. The use of a phytotoxic oil or a phytobland oil was not as effective as the use of paraquat with the residual herbicides fluorodifen, chlorbromuron or linuron.

Chlorbromuron at 2 lb/A resulted in greater than 50% stand loss of soybeans (Table 1B). Best fall panicum control resulted from linuron plus paraquat, but crabgrass control was not satisfactory. No phytotoxicity was evident with linuron at 1 lb/A. Volunteer barley was not controlled by any of the herbicides studied.

Highest soybean yields resulted when herbicide combinations contained paraquat. Treatments resulting in soybean yields over 30 bu/A were: paraquat + linuron, paraquat + fluorodifen, and paraquat alone.

Experiment B. The use of paraquat was necessary to control weeds that were present following barley harvest; linuron, alachlor, or combinations were not effective on established weeds, even with the use of a surfactant (Table 2). The best treatment for fall panicum was paraquat (0.5 lb/A) + linuron (0.5 lb/A) + alachlor (1.5 lb/A) which affected about 86% control.

Summary

Paraquat is necessary for the control of weeds present after barley harvest. None of the soybean residual herbicides, including linuron plus surfactants, affected satisfactory control of those weeds established in harvested small grain stubble; only paraquat and combinations with paraquat resulted in satisfactory control.

Best fall panicum control resulted from paraquat + linuron. Crabgrass and volunteer barley was not satisfactorily controlled with herbicides studied; however, alachlor (Lasso) or combinations were not included in the site which was infested with crabgrass.

Table 1A. Experiment A. Residual herbicides and control of weeds present after barley harvest in no-tillage soybeans, Poplar Hill Research Farm, Quantico Road, Salisbury, Maryland.

Treatment	lb/A actual	Control Ratings of Weeds Present After Barley Harvest								
		June 28, 1971			July 15, 1971			August 21, 1972		
		Marestail	Ragweed	Smartweed	Marestail	Ragweed	Smartweed	Marestail	Ragweed	Smartweed
1. Fluorodifen (Preforan)	3.0	3.3	7.0	5.7	9.0	9.0	9.0	5.3	8.7	8.3
2. Fluorodifen (Preforan) + IIE oil	3.0	6.7	6.3	6.0	8.3	8.3	6.3	7.7	9.0	5.3
3. Fluorodifen (Preforan) + phytotoxic oil	3.0	6.7	5.7	3.3	6.7	8.0	6.7	7.0	9.0	7.0
4. Fluorodifen (Preforan) + Paraquat + X-77 spreader	3.0 0.5 8 oz/100 gal water	1.0	2.3	4.0	1.0	1.7	5.7	1.7	5.3	6.3
5. Chlorbromuron (Maloran)	2.0	3.3	1.0	2.7	4.3	1.0	1.0	7.0	1.0	1.3
6. Chlorbromuron (Maloran) + IIE oil	2.0	2.0	1.0	2.3	3.3	1.0	1.0	6.7	1.0	1.0
7. Chlorbromuron (Maloran) + phytotoxic oil	2.0	2.0	1.0	5.0	4.7	1.0	2.3	8.3	1.0	2.0
8. Chlorbromuron (Maloran) + Paraquat + X-77 spreader	2.0 0.5 8 oz/100 gal water	1.0	1.0	2.0	1.0	1.0	1.0	2.0	1.0	1.7
9. Linuron (Lorox)	1.0	3.0	1.3	5.7	6.3	1.0	1.7	8.3	1.0	1.0
10. Linuron (Lorox) + IIE oil	1.0	1.7	1.3	2.0	6.0	3.7	3.7	7.7	1.7	1.7
11. Linuron (Lorox) + phytotoxic oil	1.0	1.7	1.0	7.3	3.3	1.0	2.7	7.0	1.3	4.0
12. Linuron (Lorox) + Paraquat + X-77 spreader	1.0 0.5 8 oz/100 gal water	1.7	1.0	1.0	2.3	1.0	1.0	3.3	1.0	1.0
13. Control + Paraquat + X-77 spreader	0.5 8 oz/100 gal water	1.0	2.3	3.3	1.0	1.7	4.7	1.0	2.7	6.0
14. Control + phytotoxic oil		8.3	8.0	8.3	9.0	9.0	9.0	8.0	9.0	9.0
15. Control + IIE oil		9.0	9.0	9.0	9.0	9.0	9.0	6.7	8.7	8.0
	lsd 0.05 =	2.31	1.67	3.56	2.31	2.00	3.04	3.16	0.83	3.09
	lsd 0.01 =	3.12	2.25	4.80	3.11	2.70	4.10	4.26	1.13	4.17

Table 1B. Experiment A. Residual herbicides and control of weeds present after barley harvest in no-tillage soybeans, Poplar Hill Research Farm, Quantico Road, Salisbury, Maryland.

Treatment	lb/A actual	Ratings of Species Emerging After Soybean Planting						Soybean Bu/A 11/17/71
		July 15, 1971			August 21, 1971			
		Crabgrass	Volunteer Barley	Soybean	Fall Panicum	Crabgrass	Soybean Height Reduction	
1. Fluorodifen (Preforan)	3.0	8.3	6.3	1.7	6.0	7.7	1.0	19.9
2. Fluorodifen (Preforan) + IIE oil	3.0	4.3	4.0	1.7	6.3	7.7	2.0	22.9
3. Fluorodifen (Preforan) + phytotoxic oil	3.0	4.7	5.0	1.0	7.0	6.3	1.0	23.7
4. Fluorodifen (Preforan) + Paraquat + X-77 spreader	3.0 0.5 8oz/100 gal water	4.3	6.7	1.0	5.7	5.7	1.3	32.1
5. Chlorbromuron (Maloran)	2.0	5.3	5.7	7.0	8.7	8.7	7.0	6.5
6. Chlorbromuron (Maloran) + IIE oil	2.0	4.3	5.7	6.7	7.3	7.0	7.7	5.7
7. Chlorbromuron (Maloran) + phytotoxic oil	2.0	5.3	5.3	7.7	7.0	8.7	7.7	4.5
8. Chlorbromuron (Maloran) + Paraquat + X-77 spreader	2.0 0.5 8oz/100 gal water	1.7	5.0	7.7	4.7	8.0	5.0	20.0
9. Linuron (Lorox)	1.0	5.3	5.3	3.0	8.7	8.3	3.7	18.4
10. Linuron (Lorox) + IIE oil	1.0	7.0	7.0	3.7	7.3	8.7	3.3	19.6
11. Linuron (Lorox) + phytotoxic oil	1.0	4.3	5.0	4.3	9.0	9.0	5.0	15.0
12. Linuron (Lorox) + Paraquat + X-77 spreader	1.0 0.5 8oz/100 gal water	1.0	5.0	3.3	3.0	7.0	1.7	34.6
13. Paraquat + X-77 spreader	0.5 8oz/100 gal water	4.3	7.0	1.0	4.7	7.0	1.7	36.7
14. Control + phytotoxic oil		9.0	9.0	1.0	7.7	6.3	1.0	20.9
15. Control + IIE oil		7.7	6.7	1.0	7.0	7.7	1.0	19.3
	lsd 0.05 =	3.01	2.87	1.92	2.45	N.S.	1.61	6.3
	lsd 0.01 =	4.06	3.87	2.59	3.31		2.17	8.4

Table 2. Experiment B. Residual herbicides and control of weeds present after barley harvest in no-tillage soybeans, Poplar Hill Research Farm, Quantico Road, Salisbury, Maryland.

Treatment	Rate lb/A	Control Ratings of Weeds Present after Barley Harvest				Ratings of Species Emerging After SB. Planting				Soybean Yield
		June 29, 1971		August 20, 1971		July 16, 1971		August 20, 1971		
		Marestail	Ragweed	Marestail	Ragweed	Soybean Vigor Reduction	Volunteer Barley	Fall Panicum	Soybean Vigor Reduction	Bu/A 11/17/71
1. Control		9.0	9.0	4.5	9.0	1.0	9.0	7.25	1.5	15.0
2. Paraquat[1/]	0.5	1.25	3.0	1.25	4.0	1.0	7.25	6.25	1.0	25.8
3. Linuron (Lorox) + Paraquat	1.0 0.5	1.0	1.0	1.75	1.0	1.25	7.5	5.5	1.25	26.0
4. Linuron (Lorox) + Sun oil 11E	1.0 2 gal/A	3.5	1.25	4.75	1.25	1.75	6.75	7.25	3.0	19.9
5. Linuron (Lorox) + ½% Adjuvan-T	1.0	3.0	1.0	4.75	1.0	1.75	7.5	8.25	1.75	19.7
6. Paraquat[1/] + Alachlor (Lasso)	0.5 1.5	1.0	1.25	1.25	5.25	1.0	8.25	6.5	1.5	27.1
7. Paraquat[1/] + Alachlor (Lasso)	0.5 2.0	1.25	1.0	1.0	3.5	1.0	8.25	7.25	1.0	24.7
8. Alachlor (Lasso)	2.0	9.0	9.0	5.25	8.75	1.0	7.75	6.75	1.0	19.5
9. Paraquat[1/] + Linuron (Lorox) + Alachlor (Lasso)	0.5 0.5 1.5	1.0	1.5	1.25	2.75	1.0	8.5	4.75	1.0	26.7
10. Linuron (Lorox) + Alachlor (Lasso) + ½% Adjuvan-T	0.5 1.5	5.5	2.0	6.0	2.75	1.0	8.25	7.25	1.25	21.9
11. Linuron (Lorox) + ½% Adjuvan-T	0.5	6.0	2.75	7.0	3.25	1.0	7.75	7.75	1.0	21.6
lsd 0.05=		1.94	1.41	2.81	2.32	N.S.	N.S.	1.94	N.S.	6.0
lsd 0.01=		2.61	1.89	3.79	3.12			2.62		8.1

[1/] X-77 spreader was used with paraquat at the rate of 8 oz/100 gal water.

Jimsonweed Competition in Soybeans

J. V. Parochetti
Department of Agronomy

Purpose and Objectives

Jimsonweed can be a serious weed in soybean production. Competition of several commonly occurring weeds have been studied in soybeans, but the competition of jimsonweed in soybeans has not been previously investigated. The objective of this study was to determine the effect of 3 population densities of jimsonweed on soybean yields.

Procedures

Soybeans var. Kent were planted on June 9, 1971, in a field experiment at the Wye Institute, Queenstown, Maryland. The following three jimsonweed populations were maintained at weekly intervals for the first two months: 0, 1 plant every foot and 1 plant every 3 feet. All other weeds were eliminated by hand hoeing. The experimental design was a randomized complete block with 4 replications. Each plot was 4 rows (2.5 foot spacings) measuring 10 feet by 20 feet.

The following parameters of jimsonweed were recorded on December 13, 1971: circumference of stems 1.0 inch above ground level, height, width, and seed yield. Jimsonweed seed capsules were hand harvested, seed removed, and weighed. In addition, soybean yields were taken.

Results

The average height of jimsonweed was 49 inches, average width was 44 inches, average circumference of jimsonweed 1.0 inch above ground was 2.6 inches, average seed weight of 495 g/100 ft^2. There was no significant difference within each of these parameters for the two populations of jimsonweed. However, more jimsonweed was over 3 feet tall in the

jimsonweed population spaced one plant every 1 foot than the spacing of one plant every 3 feet of row.

Soybeans from jimsonweed free plots yielded 41.5 bu/A, 25.8 bu/A for jimsonweed every foot, and 31.5 bu/A for one jimsonweed every 3 feet.

Summary

Increasing the jimsonweed population reduced soybean yields and reduced the height of jimsonweed plants. All other jimsonweed parameters measured were similar for the two population densities.

Table 1. Jimsonweed parameters and soybean yields taken December 13, 1971, from the jimsonweed competition study in soybean production.

Parameters	Jimsonweed Population		
	0	1 plant/1 ft	1 plant/3 ft
Jimsonweed			
-- height (inches)	0.0 a[a/]	51.5 b	47.0 b
-- width (inches)	0.0 a	41.8 b	47.0 b
-- stand count/100 sq. ft.			
over 3 feet tall	0.0 a	17.5 c	9.3 b
1 to 3 feet tall	0.0 a	4.3 b	3.5 b
under 1 foot	0.0 a	5.8 a	4.5 a
-- circumference of stem 1 inch above ground (inch)	0.0 a	2.5 b	2.7 b
-- seed weight/100 ft^2 (g)	0.0 a	504.5 b	485.0 b
Soybean yields (bu/A)	41.5 b	25.8 a	31.5 a

a/ Data in the same horizontal row followed by the same letter is not statistically different at the 5% level of probability according to Duncan's Multiple Range Test.

No-Tillage vs. Conventionally Planted Corn

J. V. Parochetti and F. P. Miller
Department of Agronomy

Purpose and Objectives

No-tillage corn has become increasingly popular, especially in the Piedmont area. There are many advantages for the system. Higher corn yields from no-tillage have been reported by researchers from Virginia in experiments done in the Piedmont.

The objective of this study was to compare no-tillage and conventionally planted corn on coastal plain soils. Similar studies were conducted in 1969 and 1970.

Procedures

The two sites used were located at the Wye Institute, Queenstown, Maryland, and the Tobacco Research Farm, Upper Marlboro, Maryland. The soil at the Wye Institute is a Mattapex silt loam and at the Tobacco Farm, Monmouth sandy loam. A rye cover crop was planted in the fall of 1970.

Paraquat (0.5 lb/A) + atrazine (1.25 lb/A) + simazine (1.25 lb/A) were applied at 45 gpa with a tractor pulled sprayer prior to planting Pioneer 3369A hybrid corn. Corn was planted April 30 at the Wye Institute and May 4 at the Tobacco Farm. Lime was applied at the rate of 1000 lb/A of oxides of 53.5% calcium carbonate limestone to $\frac{1}{2}$ of each plot on May 17 (Wye Institute) and May 18 (Tobacco Farm).

The following parameters were recorded during the growing season: corn height, population/A and corn yields (bu/A).

Results

A severe drought period occurred at the Wye Institute during June.

Corn in the conventionally planted plots exhibited drought stress; in contrast, the no-tillage planted corn exhibited slight evidence of drought. This drought stress is reflected in the significant differences in corn height when observed in June (Table 1). Population of corn was lower for the no-tillage planted treatment, and, no doubt, this fact plus the no-tillage mulch, resulted in the significantly higher corn yields for the no-tillage planted treatment compared to the conventionally planted corn.

At the Tobacco Farm, rainfall and moisture were not limiting. There were no significant differences in corn height, population/A of corn or corn yields between no-tillage and conventionally planted corn.

Summary

The Wye Institute location, which suffered a June drought, resulted in a significant difference in the response under no-tillage compared to conventionally planted corn. These differences were taller corn in June, lower populations and higher corn yields. At the Tobacco Research Farm location, there was no difference between no-tillage and conventionally planted corn.

Table 1. Some parameters of corn planted by no-tillage and conventional systems on coastal plain soils at the two sites, 1971.

Corn Parameters	Type of Planting	
	No-Tillage	Conventional
	Tobacco Research Farm	
Height - June 24 (cm)	70.5 a[a/]	69.9 a
Population/A, October 21	18,949 a	19,166 a
Yield (Bu/A), October 22	107.5 a	99.7 a
	Wye Institute	
Height (cm)		
-- June 11	27.6 a	23.4 b
-- June 25	80.7 a	71.8 b
Population/A, September 30	18,540 b	20,382 a
Yields (Bu/A), October 7	99.3 a	90.3 b

[a/] Data in the same horizontal row followed by the same letter are not significantly different at the 5% level of probability according to Duncan's Multiple Range Test.

Postemergence and Postdirected Broadleaved Weed Control for Soybeans

J. V. Parochetti
Department of Agronomy

Purpose and Objectives

Broadleaved weeds continued to be troublesome in soybean production. Dinoseb and 2,4-DB are used for broadleaved weed control in soybeans. In addition, bromoxynil exhibits postemergence activity on broadleaved weeds and might be useful in a soybean weed control program. The purpose of this study was to determine the relative effectiveness of 2,4-DB, dinoseb and bromoxynil postemergence and several other herbicides postdirected for broadleaved weed control.

Procedure

Two experiments were conducted in 1971 at the Wye Institute, Queenstown, Maryland. The soil of the two adjacent experiments was Mattapex silt loam with about 1.5% organic matter. Jimsonweed and a mixture of ivyleaf and tall morningglory were seeded May 28, 1971, and common cocklebur was planted June 2 at 12 inch spacings in rows 2.5 feet apart. Experimental designs were randomized complete blocks with 4 replications. Treatments in the two experiments labeled Experiment A and Experiment B were:

Experiment A. No agronomic crops were planted; plot size was 5 by 15 feet. Herbicides were applied postemergence on July 7, 1971 with an experimental sprayer delivering 30 gal/A. Cocklebur was 12 inches tall and jimsonweed and morningglory 6 inches tall or less at the time of postemergence treatment. The number of dead, injured (exhibiting epinasty) or living plants was counted in 50 sq. ft.^{2}.

Experiment B. 'Kent' soybeans were planted June 8. Postemergence treatments were applied June 17 and June 25. On June 17 soybeans were in the unifoliate stage and on June 25 soybeans were in the first trifoliate stage. Postdirected treatments were applied July 15 and July 21. On July 15, soybeans were 10 to 16 inches tall and jimsonweed was 10 inches tall. On July 21, soybeans were 13 inches tall and jimsonweed was 12 inches tall. Postemergence treatments were applied with an experimental sprayer delivering 30 gal/A. Postdirected treatments were applied by mounting nozzles on row cultivator shanks and spraying a 12 inch band in the row at 30 gal/A. The spray pattern was adjusted so that approximately 1/3 of the soybean height was sprayed. Weed control was rated on August 9 using the European rating system (Table 1).

Results

Experiment A. Distinct differences in weed control resulted from postemergence applications of 2,4-DB and dinoseb. Applications of 2,4-DB resulted in excellent cocklebur control as manifested by the low number of surviving plants (Table 2). In contrast, dinoseb at both rates without cultivation and at 1.5 lb/A with cultivation was not effective in reducing the cocklebur population. The jimsonweed population was counted for uninjured and injured plants. Dinoseb resulted in virtual limitation of jimsonweed (Table 2). Jimsonweed was injured by 2,4-DB applications as evidenced by surviving plants being stunted, deformed, and failing to flower. Cultivation of 2,4-DB treated jimsonweed did not reduce the population below the live, uninjured control. Morningglory was controlled by 2,4-DB at both rates either cultivated or not cultivated. With cultivation, dinoseb was not effective in controlling morningglory;

only at 3 lb/A was the morningglory significantly reduced without cultivation (Table 2).

Experiment B. All of the postdirected treatments resulted in commercially unacceptable (a rating of 5 (85% control) or more) jimsonweed control (Table 3). Generally, redroot pigweed control was good (2.75 to 4.25) except for a later, July 21, postdirected application of bromoxynil which resulted in unsatisfactory (6.0) control. Bromoxynil applied postemergence when soybeans were in the unifoliate or trifoliate stage resulted in near perfect jimsonweed control (Table 3). Both rates of bromoxynil applied postemergence caused about half of the soybean leaves to become necrotic and defoliate; subsequent growth from 1 lb/A bromoxynil was severely reduced, but regrowth from 0.125 lb/A was unaffected.

Summary

Postemergence applications of 2,4-DB gave good control of common cocklebur, whereas, dinoseb resulted in poor control. Best control of jimsonweed occurred with dinoseb. In contrast, 2,4-DB caused only jimsonweed injury. Morningglory (a mixture of ivyleaf and tall morningglory) was controlled by postemergence applications of bromoxynil, 2,4-DB and dinoseb (with no cultivation) at 3 lb/A. Postdirected treatments studied did not result in adequate jimsonweed control.

Table 1. Rating system for evaluating weed response utilized in these investigations.

Rating Number	% Weed Control	Remarks
1	100.0	Completely destroyed
2	97.5	Very good control
3	95.0	Good control
4	90.0	Satisfactory
5	85.0	Just satisfactory
6	75.0	Unsatisfactory
7	65.0	Poor
8	32.5	Very poor
9	0	As untreated

Table 2. The effect of postemergence herbicides on jimsonweed, morningglory and cocklebur at the Wye Institute, Queenstown, Maryland 1971.

Treatment	Rate	Live Cocklebur	Live, Uninjured Jimsonweed	Injured Jimsonweed	Live Morningglory
	lb/A	Number of Plants/50 sq. ft.			
			Cultivated		
Control	----	24.0	11.8	1.3	13.8
2,4-DB	0.2	1.3	1.5	26.3	6.5
2,4-DB	0.4	0.3	0.0	29.8	2.3
Dinoseb	1.5	22.0	1.0	0.5	7.8
Dinoseb	3.0	18.0	0.8	0.0	11.0
			Not Cultivated		
Control	----	24.0	20.3	0.0	23.3
2,4-DB	0.2	3.5	1.5	20.3	3.8
2,4-DB	0.4	0.5	0.5	45.0	0.5
Dinoseb	1.5	18.8	0.0	0.0	17.8
Dinoseb	3.0	16.3	0.0	0.0	9.5
	lsd 0.01 =	7.1	10.2	12.7	8.1

Table 3. Postemergence and postdirected herbicides in soybeans at the Wye Institute, Queenstown, Maryland, 1971.

Treatment	Rate lb/A	Date Treated	Jimsonweed Control	Redroot Pigweed Control
			August 9, 1971[a/]	
Control	----	---	9.0	9.0
Control Cultivated	----	---	1.25	1.50
2,4-DB + Linuron[bc/]	0.2 0.5	July 15	6.50	3.0
2,4-DB + Linuron[bc/]	0.2 0.25	July 15	6.25	3.50
Nitrofen + Dinoseb[c/]	2 1	July 15	6.25	3.50
Nitrofen + Dinoseb[c/]	3 1.5	July 15	6.50	2.75
Prometryne[c/]	2	July 15	6.75	5.0
Cyanazine[c/]	2	July 21	7.0	3.0
Chlorbromuron[bc/]	2	July 15	7.50	1.75
Fluorodifen[c/]	4	July 15	6.75	4.25
Bromoxynil[d/]	1	June 17	1.25	2.25
Bromoxynil[d/]	0.125	June 25	1.0	6.50
Bromoxynil[c/]	0.125	July 15	7.0	4.25
Bromoxynil[c/]	0.125	July 21	7.75	3.50
Bromoxynil[c/]	0.240	July 21	7.50	6.0
Bromoxynil[c/]	0.240	July 15	6.75	4.25
		lsd 0.05 =	1.35	2.34
		lsd 0.01 =	1.80	3.13

[a/] Visually rated using the European system on a scale of 1 to 9 with 1 = 100% control, 5 = 85% (commercially acceptable without cultivation) and 9 = 0%.

[b/] Adjuvan-T at 0.5% (v:v) added.

[c/] These treatments were postdirected to spray to lower 1/3 of soybeans in 12 inch bands.

[d/] These treatments were postemergence applications over the entire crop and weeds.

Two Anidotes for EPTC and Butylate Injury on Corn

J. V. Parochetti
Department of Agronomy

Purpose and Objectives

EPTC and butylate can injure corn. In experiments in 1969 and 1971, 1,8 napthalic anhydride (NA) prevented corn injury caused by EPTC or butylate when seed corn was treated with 0.5% NA. The objective of this experiment was to evaluate the effectiveness of R-25788 (N,N-diallyl-2,2-dichloroacetamide) and NA as anidotes against EPTC and butylate induced corn injury.

Procedures

An experimental area was selected at the Wye Institute, Queenstown, Maryland. EPTC and butylate were applied at 30 gpa with an experimental bicycle sprayer, and these plots were immediately incorporated by a Howard Rotovator at a depth of 3 to 4 inches on May 11, 1971.

Pioneer var. 3369A corn was planted May 14, 1971. Seed corn was mixed with 0.5% NA or 0.125% R-25788 immediately prior to planting. Corn was planted with a commercial John Deere plateless planter; the non-treated seed corn was planted first, the NA treated seed corn planted second, and the R-25788 treated seed corn planted last.

The experimental design was a randomized complete block with 4 replications. Row spacings were 2.5 feet and individual plots were 10 by 30 feet.

The European rating system (Table 1) was used for weed control ratings. The number of injured corn plants were counted and percentage figure calculated.

Results

A count of injured corn was taken on June 11 and the percentage of damaged corn calculated. Injured corn was stunted and twisted; severely injured corn failed to recover, but slightly injured corn did recover and produce a normal plant. EPTC at 6 lb/A resulted in 60% corn injury; 9 lb/A of EPTC resulted in 79% corn injury. When seed corn was treated with 0.5% of 1,8 napthalic anhydride, the resulting corn injury at 6 lb/A of EPTC was 2.5% and 9 lb/A EPTC was 5%. Injury from 3 and 9 lb/A of EPTC when seed corn was treated with a 0.125% R-25788 was 0.8 and 1.3%, respectively. The resulting corn injury with high rates of EPTC and butylate and the lack of a seed anidote resulted in significantly lower yields than when corn was protected. Untreated corn planted in butylate at 16 lb/A caused 32% corn injury. When corn was treated with 1,8 napthalic anhydride, less than 0.5% of the corn was injured at 16 lb/A butylate, and no corn injury was noted at 16 lb/A with butylate with seed corn treated with R-25788.

Highest yields were noted (104 bu/A) using 16 lb/A of butylate with corn treated with 0.125% R-25788. Low yields without herbicides are due to weed competition since no cultivation was employed in these studies.

Summary

The two anidotes, 1,8 napthalic anhydride (NA) and R-25788, were effective in preventing corn injury when seed corn was treated. Untreated seed corn germinating and growing in EPTC and butylate at 9 and 16 lb/A was severely injured; in contrast, corn plants growing in similarly treated soil from treated seed corn were not injured.

Table 1. Rating system for evaluating weed response and crop injury utilized in these investigations.

Rating Number	% Weed Control	Remarks	% Crop Injury	Remarks
1	100.0	Completely destroyed	0	No injury
2	97.5	Very good control	2.5	May be injured
3	95.0	Good control	5.0	Injured slightly
4	90.0	Satisfactory	10.0	Injured, but satisfactory
5	85.0	Just satisfactory	15.0	Injured, barely satisfactory
6	75.0	Unsatisfactory	25.0	Not satisfactory
7	65.0	Poor	32.5	Injured, bad
8	32.5	Very poor	65.0	Injured, very bad
9	0	As untreated	100.0	Completely destroyed

Table 2. Two anidotes for EPTC and butylate injury on corn, Wye Institute, Queenstown, Maryland.

	Treatments[a]	Rate lb/A	Seed Treatment	6/11/71 % Corn Injury	8/3/71 Foxtail	8/3/71 Velvetleaf	8/3/71 Lambsquarters	10/6/71 Corn bu/A
1.	Control		Untreated	0.0	9.0	9.0	9.0	18.1
2.	EPTC (Eptam)	3.0	Untreated	5.4	1.5	1.25	2.75	78.5
3.	EPTC (Eptam)	6.0	Untreated	59.4	1.0	1.0	1.75	42.0
4.	EPTC (Eptam)	9.0	Untreated	78.7	1.25	1.0	1.0	44.5
5.	Butylate (Sutan)	4.0	Untreated	1.3	1.0	1.5	5.25	48.8
6.	Butylate (Sutan)	8.0	Untreated	2.5	1.0	1.0	5.5	79.8
7.	Butylate (Sutan)	16.0	Untreated	31.8	1.0	1.0	2.75	76.0
8.	Control		½% 1,8 napthalic anhydride[b]	0.4	9.0	9.0	9.0	3.0
9.	EPTC (Eptam)	3.0	½% 1,8 napthalic anhydride	0.0	1.25	1.0	3.5	61.3
10.	EPTC (Eptam)	6.0	½% 1,8 napthalic anhydride	2.5	1.0	1.0	1.25	84.7
11.	EPTC (Eptam)	9.0	½% 1,8 napthalic anhydride	5.0	1.25	1.0	1.25	71.7
12.	Butylate (Sutan)	4.0	½% 1,8 napthalic anhydride	0.0	3.0	3.75	5.5	40.1
13.	Butylate (Sutan)	8.0	½% 1,8 napthalic anhydride	0.0	1.25	1.25	4.75	96.9
14.	Butylate (Sutan)	16.0	½% 1,8 napthalic anhydride	0.4	1.0	1.0	2.75	88.2
15.	Control		1/8% R-25788	0.0	9.0	9.0	9.0	12.6
16.	EPTC (Eptam)	3.0	1/8% R-25788	0.8	1.0	1.75	3.0	76.5
17.	EPTC (Eptam)	6.0	1/8% R-25788	0.8	1.0	1.0	2.0	96.8
18.	EPTC (Eptam)	9.0	1/8% R-25788	1.3	1.0	1.0	1.5	96.1
19.	Butylate (Sutan)	4.0	1/8% R-25788	0.9	1.0	1.75	6.75	59.8
20.	Butylate (Sutan)	3.0	1/8% R-25788	0.0	1.0	1.0	3.5	64.9
21.	Butylate (Sutan)	16.0	1/8% R-25788	0.0	1.0	1.0	3.75	104.0
			lsd 0.05 =	5.79	1.32	1.35	2.11	32.1
			lsd 0.01 =	7.70	1.75	1.79	2.81	42.7

[a] EPTC and butylate are recommended and registered at 3 and 4 lb/A, respectively.

[b] This product is registered and sold as PROTECT, a product of Gulf Research and Development Co., Merriam, Kansas.

Performance of Winter Malting Barley Strains in Maryland

J. G. Shannon and J.A. Schillinger
Department of Agronomy

Purpose and Objectives

Malting barley, as a crop, has potential in Maryland because of the many beer industries located along the East Coast. The two-rowed barley variety, Tschermak, is currently the only variety with malting quality being grown in Maryland. This variety has not yielded as well as the six-rowed feed varieties such as Barsoy. In order for malting barley to compete well in Maryland, it should have yield potential equal to current feed varieties. Thus, higher yielding varieties with malting potential are needed to make malt barley culture in Maryland more feasible.

Procedure

Several strains of winter barley with malting potential were obtained from Michigan State and Cornell Universities. They were evaluated in a randomized complete block design with four replications at the University of Maryland (Poplar Hill) Agronomy Research Farm near Quantico, Maryland. Comparisons for yield and test weight were made between these strains and the check varieties Tschermak and Barsoy.

Samples of each strain, with the exception of Barsoy, were also evaluated for malting quality at the Barley and Malt Laboratory in Madison, Wisconsin.

Results

Yield and bushel weight for several barley strains, with malting potential, as compared to Tschermak and Barsoy, are presented in Table 1. All six-rowed malting strains evaluated offered yield improvements over Tschermak. However, they did not yield as well as Barsoy, a popular feed-type

b/ This product is registered and sold as PROTECT, a product of Gulf Research and Development Co., Merriam, Kansas.

grown in Maryland. Although yields of these strains were lower than Barsoy, several were still high enough to compete with the feed variety.

Evaluations of lines for malting quality are presented in Table 2. A popular spring malting variety, Larker, grown in the Midwestern United States, was added as a check. Seed of Larker was supplied by the Barley and Malt Laboratory, thus, it was not grown under Maryland conditions.

Kernel plumpness percentages of six-rowed varieties were intermediate, whereas plumpness of the two-rowed strains MSU 420-11 and Tschermak were higher than the other strains. Agtron hull scores were low, but as a whole, not lower than the Midwestern variety, Larker.

Malt extracts were all high and several diastatic powers were low. These two tendencies were related to low nitrogen, especially in the case of Tschermak. Low nitrogen or protein content of Maryland grown six-rowed strains, as compared to Larker, may have been environmental.

Diastatic power, a measure of enzymatic potential for converting starch to malt, was highest for NY6005-19. No strain was as high as Larker in diastatic power, but this could be related to high protein content. Strains rated best for malting quality were the New York strains, with NY6005-19 being first because of better diastatic power. Tschermak was rated near the bottom as far as malting quality is concerned.

Summary

Several winter barley strains with malting potential were evaluated at the University of Maryland (Poplar Hill) Agronomy Research Farm near Quantico, Maryland. These lines were compared to Tschermak, the current malting variety, and Barsoy, a popular high-yielding feed barley.

Most strains were better than Tschermak in malting quality and yield. In comparison to Barsoy, malting lines were lowest in yield, but several strains were high enough in yield to compete with Barsoy. Thus, several lines evaluated appear to offer much improvement over Tschermak.

Table 2. Evaluation of barley and malt quality for several strains grown in Maryland.

Univ. of Md. Selections	BARLEY			MALT EXTRACT (% dry basis)		WORT		NITROGEN (% dry)			Dia-Static Power (Deg)	AMYLASE	
	Kernel Weight (mg)	Plump-ness (%)	Color Score (Agtron)	Fine Grind	Coarse Grind	Color	Clarity	Barley	Malt	Wort		Maltase Equiv	20° Unit
MSU 420-11	33.7	74.6	30	80.5	75.1	1.4	clear	1.80	1.78	.679	133	429	31.3
Larker *	31.2	70.3	32	77.0	75.3	1.6	clear	2.04	1.95	.675	181	626	40.7
MSU 447-18	34.6	72.4	24	79.5	74.8	1.6	hazy	1.72	1.67	.550	112	373	24.5
MSU 448-19	33.2	56.7	30	78.4	75.8	1.7	hazy	1.72	1.64	.660	126	404	30.8
MSU 448-24	32.3	64.4	26	79.5	76.6	1.7	hazy	1.71	1.65	.673	124	395	30.8
Cass	33.1	59.2	32	79.2	74.7	1.7	clear	1.75	1.65	.657	122	394	29.4
NY 6005-15	27.8	52.0	30	78.2	73.9	1.6	hazy	1.81	1.76	.684	147	497	28.3
NY 6005-18	30.3	59.0	30	78.9	72.2	1.6	hazy	1.76	1.70	.687	136	448	29.9
NY 6005-19	27.8	52.0	28	79.1	76.0	1.6	hazy	1.82	1.74	.748	169	550	37.6
MO B475 (C119168)	29.7	53.6	42	78.6	75.3	1.0	hazy	1.72	1.73	.636	131	433	28.2
Tschermak	32.5	84.0	22	81.9	78.4	1.9	hazy	1.53	1.54	.576	95	299	25.7

*Sample of Larker supplied by Barley and Malt Laboratory; not grown in Maryland.

Table 1. Yield and test weight of several malting barley strains grown at Poplar Hill, Maryland, 1971

Entry	Yield (Bu/A)	Rank	Bushel Weight lbs.
MSU 420-11 (2)*	36.7	12	48
MSU 448-12 (6)	52.6	9	48
MSU 447-18 (6)	64.8	3	48
MSU 448-19 (6)	67.9	2	47
Cass (6)	57.1	6	48
NY 6005-15 (6)	62.4	5	49
NY 6005-18 (6)	63.0	4	47
NY 6005-19 (6)	56.1	8	47
MO B475 (6)	57.0	7	47
Tschermak (2)	44.7	10	47
Barsoy (6)	68.7	1	--
$Lsd_{.05}$	11.1		NS

* Number in parenthesis following entry indicates two-rowed or six-rowed.

Response of Corn to Irrigation as Affected By Moisture Deficit, Age of Plants and Hybrid

R.G. Rothgeb and J.G. Shannon
Department of Agronomy

Purpose and Objectives

This is a third-year report on the response of corn hybrids to timely irrigation on a Mattapex silt loam located on the Wye Institute Farm. The objectives of this experiment were:

(1 To determine the effect time of planting on the need and effectiveness of irrigation;

(2 To compare hybrids for response to irrigation.

Procedure

Six hybrids, paired for maturity, were included in this study, as in previous years. Due to prevalence of corn leaf blight in 1970, only two of the six varieties grown in 1970 were grown in 1971. DeKalb XL44 and DeKalb XL66 replaced DeKalb XL45 and $Wf9xOH_{43}$ in the early maturing group. Mid-season hybrids, Pioneer 3369A and Pioneer 3334, replaced Pioneer 3306 and $H55xOH_{43}$. The late season hybrids were the same as in 1970.

Data were obtained for three planting dates, April 27, May 14, and May 24. Each date was planted on both an irrigated and a non-irrigated block. Hybrids were hand-planted in three row plots fifteen feet long in each of four replications.

Each plot contained approximately 60 plants. Cultural practices were uniform over both moisture treatments. Irrigation was done by four overhead rotary sprinklers and was applied as needed.

Rainfall and irrigation totals in inches were as follows:

	June	July	August
Rainfall	1.53	2.17	10.64
Irrigation	1.00	2.50	0

Results

Yields of corn hybrids under irrigation and no irrigation at each of three planting dates are shown in Table 1. Highest yields were obtained from irrigated treatments in 17 of 18 comparisons. At least a 25 bushel/acre advantage for irrigation over no irrigation is shown for 16 of the 18 comparisons.

Response to irrigation varied with planting date and hybrid. Yields of irrigated treatments were greatest for the first date of planting with mid-season hybrids having highest yields.

Irrigated hybrids showed a consistent yield advantage at all planting dates, with the exception of DeKalb XL44 which showed an 84.7 bushel increase with irrigation at the first planting date and little response at the last two planting dates.

After three years of evaluation, no consistent results have been found for irrigation and non-irrigation treatments as related to hybrid or planting date. Response appears to be very dependent upon rainfall distribution.

Generally, if there was moisture stress during early June to mid-July, irrigation was most effective for early planting dates. This stress period corresponded closely with the grain-forming period, just before silking and during silking for the early planted material. If stress periods occurred during mid to late July, later planting dates showed more response to irrigation than the earliest date. Again, these stress periods corresponded to growth stages prior to, and during, silking. This emphasizes the importance of adequate moisture during the grain-forming period.

Summary

Six corn hybrids, two early, two mid-season and two full-season, were evaluated under irrigation and non-irrigation. Highest yields were obtained from irrigated treatments in 17 of 18 comparisons.

Response to irrigation varied for planting date and hybrid. Hybrids showed the greatest response in 1971 for the earliest planting date; however, this was not consistent over the entire three-year study. Greatest yield increases due to irrigation were found to depend on moisture stress during growth stages just prior to, and during, silking. If rainfall was plentiful at this growth stage, there was little response of hybrids to irrigation.

Table 1. Yield Response of Six Corn Hybrids, Planted at Each of Three Dates to Irrigation and No Irrigation. Queenstown, Maryland, 1971.

HYBRID	DATES: April 29 IRR[1]	April 29 N.I.	April 29 IRR-N.I.[2]	May 14 IRR.	May 14 N.I.	May 14 IRR-N.I.	May 24 IRR.	May 24 N.I.	May 24 IRR. N.I.
DeKalb XL44 (E)*	135.2	50.5	+84.7	79.9	80.9	- 1.0	91.3	76.4	+14.9
DeKalb XL66 (E)	134.5	82.3	+52.2	128.7	88.8	+39.9	115.5	84.9	+30.6
Pioneer 3369A (M)	157.6	117.4	+40.2	142.2	109.7	+32.5	135.5	90.1	+45.2
Pioneer 3334 (M)	175.5	113.7	+61.8	136.7	111.0	+25.7	143.8	95.6	+48.2
Crib Filler 66 (F)	120.9	56.5	+64.4	88.5	55.9	+32.6	94.9	58.7	+36.2
C103 RFxH84 (F)	135.9	92.1	+43.8	123.5	96.5	+27.0	124.7	79.2	+45.5
Average	142.9	85.4	+57.5	116.6	90.4	+26.2	117.5	80.8	+36.7

1] IRR - irrigated; NI - non-irrigated

2] Difference between Irrigated and Non-irrigated

* The letters (E), (M) and (F) following each hybrid indicate early, mid-season, and full-season, respectively.

Breeding Soybeans that Respond to Potassium Fertilization

J. A. Schillinger
Department of Agronomy

Purpose and Objectives

Soybeans continue to be the leading agricultural export of the United States, and their utilization by domestic processors has also increased over recent years. However, despite favorable growing conditions of much of the major soybean producing areas in 1971, soybean production per acre has not improved significantly over the last five years.

Soybean varieties now available to farmers do not respond to fertilizers unless soil tests are low for phosphorus and/or potassium. The objectives of these studies are: (1) to isolate soybean genotypes that will respond to K, (2) to identify mechanisms within the plants that cause response to K, and (3) to incorporate genes for response to K into improved, adapted soybean varieties.

Procedures

Selected responding (PI 31702) and non-responding (Lincoln) soybean genotypes were studied for growth, yield, and K uptake while growing under three levels of K fertilization in the field. The three K levels were of 0, 150, and 400 pounds of K_2O/acre applied and disked into the soil prior to planting. Each plot consisted of four rows 20' long, and each treatment was replicated five times.

Leaf samples were taken at weekly intervals from the most recent expanded trifoliate leaflet. Sampling began on July 15 and continued through September 23. Leaf samples were oven-dried, ground, weighed, and submitted to the University of Maryland Plant Analysis Laboratory for mineral analysis. Pod and seed samples were taken on September 9, 16, and 25 and also analyzed for mineral content.

Pod counts were taken on October 20 by selecting 50 plants from the center rows of each plot. The plots were harvested for yield on October 21 by threshing two 16' rows from the center rows of each plot. Yield samples were air dried to 12.5% moisture, weighed and converted to bushels per acre. Seed size samples were taken for each treatment by counting and weighing 300 seeds.

Results

Yield data from 1971 again showed a unique response to K fertility among PI 31702 and Lincoln soybean genotypes (Table 1). An increase of 56% for PI 31702 in K_3 versus K_0 compares favorable with the average % response of +39% for 1968-70. It was encouraging to see a significant response to K at the intermediate K level (K_1). Also of major importance is the fact that the unadapted, unselected PI 31702 yielded significantly more than Lincoln at the K_3 level and similar to Lincoln at the intermediate K level. Lincoln appears to have a unique ability to produce under low potassium conditions. The difference in genotypic response to K is real as is indicated by the highly significant (1% level of probability) interaction of varieties by potassium level.

Data on pods per plant and grams per 100 seed give reasons for the differences in yield (Table 2). Pods per plant and seed size for Lincoln did not change significantly under the K_1 and K_3 treatments. However, PI 31702 produced more pods per plant and larger seed when it was grown under the K_1 and K_3 treatments. The percentage increase in seed size was 9.7 for K_3 versus K_0. This again compares favorably with the 1969 and 1970 data when 9 and 15% increases in seed size were detected under similar potassium regimes.

Leaf samples taken at weekly intervals beginning at July 15 showed a unique pattern of K-content in the leaves of K-responding and non-responding genotypes during the growing season (Table 3). The summary of the analysis of variances in Table 3 shows that significant differences in K content in the

leaves occurred between varieties beginning on August 26 and continuing through September 16. A significant interaction of genotype x potassium level was detected on September 2 through September 16. Prior to August 26, the percentage of K in the leaves was similar for both responding and non-responding genotypes. Apparently the responding genotypes are capable of maintaining a more advantageous level of K in the leaves during the very critical flowering and pod-filling stages.

Summary

1. PI 31702 showed a significant response to K by producing a greater yield (29.0 vs 45.3 bushels per acre) more pods/plant and larger seed.
2. Lincoln again failed to utilize the added K and produced no increases in yield, pods/plant, or seed size.
3. Response in PI 31702 may be attributed to an ability to maintain adequate K levels in the leaves during the critical pod-filling stage.

Table 1. Response in Yield of PI 31702 and Lincoln Genotypes to Potassium. 1971

Genotype	Yield (Bushels/Acre) K_0 1/	K_1 1/	K_3 1/
Lincoln	42.1	40.7	41.4
% increase over K_0		- 3.4	- 1.7
PI 31702	29.0	41.5	45.3
% increase over K_0		+43.4	+56.2

Analysis of Variance

	M.S.	F
Reps	55.01	8.30*
Potassium	97.26	14.68*
Error 'a'	6.63	
Genotype	35.28	4.97
Genotype x Potassium	121.96	17.17**
Error 'b'	7.11	

LSD_{05} = 5.33

CV (%) = 6.66

1/ K_0 = no potash added - Soil test = 70L
K_1 = 150 lbs/A potash added - Soil test = 135M
K_3 = 400 lbs/A potash added - Soil test = 202H

2/ ** indicates significant differences at 1% level of probability.

Table 2. Response of PI 31702 and Lincoln Soybean Genotypes to Potassium. 1971.

Genotype	Pods/Plant[1/]			Grams/100 seed[3/]		
	K_0[2/]	K_1	K_3[2/]	K_0	K_1	K_3
Lincoln	1229	1190	1112	17.6	17.4	17.3
PI 31702	1128	1323	1518	18.6	19.6	20.4

1/ Based on 50 plants/rep and average of 3 replications.

2/ K_0 = no potash added; Soil test level - 70L
K_3 = 400 pounds K_2O/Acre; Soil test level - 202H

3/ Average is based on a combined sample of 900 seeds.

Table 3. % K in Soybean Leaves of Lincoln and PI 31702 at 11 Sampling Dates. 1971.

Date	Lincoln		PI 31702		Analysis of Variance: Significant Difference of Treatment		
	K_0	K_3	K_0	K_3	Genotype	Potassium	Gen x Pot
7-15	1.96	2.38	1.98	2.38		**[1/]	
7-22	1.66	2.24	1.78	2.34		**	
7-29	1.96	2.52	1.98	2.40		**	
8-05	1.80	2.34	1.94	2.42		**	
8-12	1.60	2.10	1.62	2.16		**	**
8-19	1.10	1.66	1.46	1.72		**	
8-26	.94	1.32	1.24	1.88	**	**	
9-02	.80	1.16	.94	1.58	**	**	*
9-09	.65	.88	.95	1.43	**	**	*
9-16	.26	.42	.64	1.02	**	**	**
9-23	.40	.86	.46	.92		**	

1/ * indicates significant differences were found at 5% level of probability.

** indicates significant differences were found at 1% level of probability.

Comparison of Methods of Planting Soybeans after Barley

J.A. Schillinger, R. Hutchison, R. Mulford, L. Smith
Department of Agronomy

Purpose and Objectives

The practice of planting soybeans after barley has become very popular in Maryland. A profitable return from soybeans planted in a double-cropping system is mainly contingent upon the moisture availability through the shortened growth cycle. The no-tillage method of planting has been shown to conserve soil moisture when an adequate mulch is present and, in addition, the loss of soil moisture to evaporation after plowing is avoided by no-tillage planting. However, with no-tillage planting of soybeans new problems are encountered, such as uncertain weed control, effect of stubble on early soybean growth, and obtaining adequate plant stands.

The objectives of this study were to compare no-tillage and conventional methods of planting soybeans after barley and to determine the best variety of soybeans for no-tillage double-cropping.

Procedures

Barsoy barley was seeded in a uniform soil at the Wye Institute, Quantico and at Clarksville during the fall of 1970. The barley was uniformly topdressed with 400 pounds per acre of 10-20-20 in March. After the barley was harvested in June, the land was divided into conventional and no-tillage treatments. The conventional land was plowed, disked once, and the soybeans were planted either with a grain drill at 90 pounds/acre or in 30" rows at 45 pounds/acre. A 20" row width was used with the no-tillage planting method, and the seeding rate was set at 60 pounds/acre. Weeds were controlled by applying Paraquat at $1\frac{1}{2}$ pints/acre, Lasso at $2\frac{1}{4}$ quarts/acre, and Dinitro at 6 quarts/acre.

The soybean varieties used at each location included Calland and Cutler at Clarksville, Wye and York at Queenstown, and Kent and York at Quantico.

Results

The yields of soybeans in the different treatments are presented by location in Tables 1, 2, and 3. The no-tillage plantings in 20" rows did not show an advantage over the conventional 7" drill plantings. In fact, at Clarksville, (Table 1) the conventionally planted Calland and Cutler varieties out-yielded the no-tillage plantings by 6,8 and 11.5 bushels/acre, respectively. The average difference was significant at the 1% level of probability.

The average soybean yields in the two methods of planting were similar at the Queenstown location (Table 2). The only significant difference in yield between planting methods was found for the Wye variety.

At Quantico (Table 3), the no-tillage method of planting was consistently superior in yield for both the Kent and York soybean varieties. The conventional row width of 30" was used at this location and not at Queenstown or Clarksville.

Summary

The no-tillage method of planting soybeans after barley produced higher yields than conventionally planted soybeans only at Quantico. While the yields of the Wye soybean variety were higher in the no-tillage plantings at Queenstown, those of York were similar in both methods of planting. At Clarksville, the conventionally planted soybeans yielded significantly more than the no-tillage soybeans.

Table 1. Effect of Planting Method on Soybean Yields Following Barley. Clarksville - 1971.

	Row Width	Yield (Bu/A) Calland	Cutler	Average
No Till	20"	35.2	33.2	34.2 a [1/]
Conventional	7"	42.0	44.7	43.4 b

1/ Averages noted by a different letter are significantly different at 1% level of probability.

Table 2. Effect of Planting Method on Soybean Yields Following Barley. Queenstown - 1971.

	Row Width	Yield (Bu/A) Wye	York	Average
No Till [1/]	20"	44.4 a [2/]	43.9 a	44.2 a
Conventional	7"	39.8 b	44.7 a	42.4 a

1/ Averaged five days later in maturity.

2/ Variety yields noted by different letter are significantly different at 5% level of probability.

Table 3. Effect of Planting Method on Soybean Yields Following Barley. Quantico - 1971.

	Row Width	Yield (Bu/A) Kent	York	Average
No Till [1/]	20"	44.6 a [2/]	39.9 a	42.3 a
Conventional	30"	41.4 b	34.6 b	38.0 b

1/ Averaged four days later in maturity.

2/ Variety y lds noted by different letter are signi i antly different at 5% level of probability.

Evaluation of Selected Alfalfa Strains for Yield, Persistence, and Resistance to Anthracnose

J. A. Schillinger and T. E. Devine
Department of Agronomy and U.S.D.A.

Purpose and Objectives

Alfalfa is correctly called the "Queen of the Forage Crops". However, in order to keep this royal position, continued improvement in forage yield and persistence of stands must be realized to meet new demands of increased production costs. Anthracnose, Colletotrichum trifolli, is a highly destructive pathogen of alfalfa, and the disease results in heavy stand losses. The objective of this study was to evaluate 15 alfalfa varieties and advanced breeding lines for their yield, persistence, and resistance to anthracnose.

Procedure

On March 21, 1970, 14 alfalfa varieties and lines were seeded at the rate of 18 lbs germinable seed/acre. A randomized complete block design was used with four replications. Plot size was 5' x 16' with a 3' x 13' harvest strip taken for yield evaluations. Vernam at 3 lbs A.I./acre was applied and thoroughly incorporated prior to planting. The soil pH and fertility were adjusted by adding 1000 lbs/A of Dolomitic limestone and 500 lbs/A of 5-20-20 fertilizer.

Five harvests were made in 1971 on the following dates: May 16, June 24, July 20, September 1, and October 19. Yields were adjusted to 12% moisture to approximate the moisture of hay. Assessment of anthracnose infection was made on September 9, and yellowing due to potato leafhopper feeding was estimated on July 23.

Results

Data collected from these plots in 1971 are presented in Table 1. The performance of $MSHp6FAn_2W_2$ after one cycle of selection for anthracnose resistance showed a significant improvement in anthracnose resistance in addition to forage yield. $MSHp6FAn_2W_2$ had one of the lowest anthracnose scores (1.4) and produced the highest seasonal yield of 7.16 tons per acre of forage. In comparison, Team and Saranac produced only 6.74 and 6.41 tons per acre, respectively, and had anthracnose scores of 2.3 and 3.9. A bonus with the $MSHp6FAn_2W_2$ strain was a low incidence of yellowing due to potato leafhopper effects.

Summary

Fourteen alfalfa varieties and advanced breeding lines were evaluated for forage yield, anthracnose resistance, and tolerance to potato leafhopper yellowing. $MSHp6FAn_2W_2$, a strain selected for anthracnose resistance, produced the highest annual forage yield of 7.16 tons per acre in 1971.

Table 1. 1971 Data from Alfalfa Variety and Strain Test for Yield Persistence and Anthracnose Resistance at Wye Mills, Maryland.

Broadcast plots: 5 feet by 16 feet.
Randomized block, 4 replications.
Seeded: March 1970.
Limed: 1,000 lbs/A dolomitic limestone and fertilized with 500 lbs/A 5-20-20.

Rate of seeding: 18 lbs/A, 3 lbs Vernam/A at seeding.
Cropping history: Corn prior to alfalfa.
Soil type: Mattapex silt loam.
Annual fertilizer: 800 lbs/A 0-15-30 with borax, spring application.

Entry	Yield in tons/acre[1/]						Anthracnose Damage Score[2/]	Yellowing Score[3/]
	May 16	June 24	July 20	Sept. 1	Oct. 19	Total	9/29	7/23
Bonanza	1.72	1.65	.69	.76	.75	5.57	2.6	6.5
Cherokee	2.96	1.84	.63	.96	.71	7.10	2.6	2.0
DuPuits	2.92	1.93	.65	.89	.54	6.93	4.5	4.8
Florida 66	2.05	1.63	.75	.86	.87	6.16	2.3	5.0
Moapa	1.45	1.59	.71	.82	.68	5.25	3.0	8.0
Saranac	2.56	2.00	.60	.76	.49	6.41	3.9	2.8
Team	2.74	1.87	.65	.86	.62	6.74	2.3	3.3
Weevlchek	2.58	1.84	.72	.87	.53	6.54	2.5	2.0
Williamsburg	2.41	1.94	.70	.86	.63	6.54	2.9	4.5
MSA-CW3	2.56	1.78	.65	.94	.86	6.79	1.0	1.3
MSHp6FAn2W2	2.67	1.96	.67	.90	.96	7.16	1.4	1.8
MSHp6FOV	3.00	1.85	.61	.97	.70	7.13	3.1	1.8
MSHpB3	2.17	1.94	.68	.88	.88	6.55	2.3	5.0
MSHp8	2.76	1.77	.63	.88	.89	6.93	2.5	2.8
Average	2.47	1.83	.67	.87	.72	6.56	2.62	3.67
"F" value	5.16**	1.60 N.S.	1.38 N.S.	.79 N.S.	2.25*	.32 N.S.	9.78**	15.44**
LSD (.05)	.59	-	-	-	.30	-	0.809	1.5
LSD (.01)	.80	-	-	-	-	-	1.082	2.0
CV (%)	16.00	11.00	7.00	16.00	7.00	7.00	22.00	28.00

1/ Yield at 12% moisture.
2/ Scored 1 to 5: 1 = least damage, 5 = most damage. Scored primarily on frequency of dead or dying stems. Anthracnose symptoms first noted 7-23-71.
3/ Foliar yellowing scored 0 to 9: 0 = least yellowing, 9 = most yellowing. Cause undetermined.

Maryland Soybean Variety and Strain Tests

J. A. Schillinger
Department of Agronomy

Purpose and Objectives

With the advent of many new soybean varieties, it is important that evaluations of all soybean varieties available to Maryland farmers be made in such a way as to give farmers an accurate indication of their yielding potential. Variety tests were conducted under various cropping systems, soil types, and row widths to provide information on varietal performance under an array of practical conditions.

In addition to tests of released varieties, tests of advanced breeding lines of soybeans are conducted in cooperation with the Agricultural Experiment Stations of Delaware, New Jersey, Pennsylvania, and Virginia. These tests were conducted at four locations, namely, Clarksville, Crumpton, Wye Institute, and Quantico.

Procedures

The locations were selected to conduct the 1971 Maryland Soybean Variety Tests. Soil type, planting date, row width, and average yields for each location are presented in Table 1. A randomized, complete block design with three replications was used at each site. Entries were seeded either in a 3-row plot using the same row width of the cooperating farmer, or in 5-row plots with 15" row widths. Row widths used at each site are given in Table 1.

Results

Growing conditions at each location are indicated by the average yield at that location (Table 1). Generally, growth of early varieties was hampered by a drought in July, and plant height was shorter than in previous years. Later maturing varieties did benefit by late rains. Tests planted after barley produced good yields in 1971 because of ample rainfall in August and September.

Average yields of the soybean entries from the Eastern Shore locations of the Maryland Soybean Tests are presented in Table 2. It is obvious from this data that Essex (V-180) is a superb soybean variety for Maryland's Eastern Shore. Its performance was the most consistent among the entries tested from location to location and from early planting vs. planting after barley. Williams, a 1971 release, also performed well in these tests.

In the Piedmont region of Maryland, Williams, Calland, Cutler, and Wye were the top producers, having the highest average yield over three locations in this region (Table 3).

Results from the Mid-Atlantic regional tests are presented in Tables 4, 5, and 6. In the Maturity Group IV tests at three locations, Cutler and Wye were the top yielding varieties, and none of the advanced breeding lines showed much promise.

In the Maturity Group IV and V tests (Table 5), several breeding lines showed good yielding potential. Md 69-410 outyielded Kent by 5.8 bushels and Delmar by 10.3 bushels per acre. Md 69-410 was submitted to the U.S. Regional tests for 1972. V 68-1365 and V 68-1156 both outyielded York by 4.7 and 1.1 bushels per acre, respectively, in the Maturity Group V tests.

Summary

Maryland Soybean Variety Tests were conducted at ten locations. In the Eastern Shore tests, the Essex (V-180) variety outyielded all other varieties in full season and after barley plantings. Williams, Calland, Cutler, and Wye all performed well in the Piedmont area of Maryland.

Mid-Atlantic regional tests of advanced soybean breeding lines were conducted at three locations. Only three breeding lines of the thirty-two tested exceeded the the check varieties Cutler, Kent, and York. These breeding lines - Md 69-410, V 68-1365, and V 68-1156 - will be advanced to the U.S. Regional Soybean Tests in 1972.

Table 1. Location, Soil Type, Planting Date, and 1971 Average Yield of Maryland Soybean Variety Tests, 1971.

Cooperator and Location	Soil Type	Planting Date	Row Width	Av. Yield (Bu/A)
Ron Mulford Princess Anne	Mattapex Silt Loam	6-03	40"	37.9
Ron Mulford University of Maryland Quantico (Poplar Hill Farm)	Downer Sandy Loam	5-24	30"	40.8
	Mattapex Silt Loam	6-25	15"	43.6
Calvert Collins Hurlock	Sassafras Sandy Loam	7-02	30"	40.0
Dr. J. Johnson Linkwood	Sassafras Sandy Loam	5-26	36"	32.5
Lewis Smith University of Maryland Queenstown Wye Institute	Mattapex Silt Loam	5-26	30"	45.2
	Mattapex Silt Loam	6-15	15"	48.7
Philip Norton Crumpton	Downer Sandy Loam	6-28	30"	28.3
Frank Leaverton Chestertown	Sassafras Loam	5-29	40"	43.5
Tom Blaney University of Maryland Clarksville	Manor Silt Loam	5-27	30"	36.5
David Sparks Upperco	Chester Silt Loam	6-10	15"	37.8
Ken Stonesifer Taneytown	Penn-Reading Loam	6-10	15"	39.7
		7-13	15"	31.6

Table 2. Average Yield (Bu/A) of Soybean Varieties on the Eastern Shore when Planted as a Full Season Crop and After Barley, 1971.

Full Season			After Barley		
Variety	Maturity	Yield	Variety	Maturity	Yield
V-180 (Essex)	V	46.8	V-180 (Essex)	V	48.6
Md 410	V	45.2	Williams	III	46.1
Columbus	IVs	44.9	York	V	45.7
Md 1327	IVs	44.7	Md 410	V	45.3
Cutler	IV	43.9	D-128	V	44.4
Williams	III	43.7	Mack	V	44.3
Kent	IV	43.2	Calland	III	43.6
Delmar	IVs	41.9	Cutler	IV	42.7
Wye	IV	41.3	Kent	IV	41.8
Md 100	IVs	40.6	Columbus	IVs	41.6
SRF-400	IV	40.3	Wye	IV	41.6
Mack	V	39.5	Dare	V	39.4
York	V	39.0	SRF-307	III	38.5
SRF-307	III	38.4	Wayne	III	37.8
Wayne	III	37.4	Md 100	IVs	36.2
Calland	III	37.2	Md 1327	IVs	36.0
Dare	V	37.1	Delmar	IVs	35.5
D-128	V	35.7	SRF-400	IV	34.1

Table 3. Average Yield (Bushels/Acre) of Soybean Varieties Planted in the Piedmont Area of Maryland as Full Season Crop, 1971.

Variety	Maturity Group	Yield (Bu/A)
Williams	III	42.5
Calland	III	42.0
Cutler	IV	41.2
Wye	IV	40.9
SRF-400	IV	39.9
SRF-307	III	39.0
Wayne	III	39.0
Kent	IV	38.6
Beeson	II	37.4
Columbus	IVs	36.7
Md 100	IVs	35.7
Corsoy	II	31.8

Table 4. Average Yield (Bushels/Acre) of Soybean Breeding Lines of Maturity Group IV in Mid-Atlantic Region Tests. (Summary of three Maryland locations.)

Variety	Yield (Bu/A)				
	Full Season	After Barley			
	Clarksville	Crumpton	Quantico	$\bar{x}$	Rank
Clark 63	35.4	19.7	35.4	30.2	10
Cutler	41.0	27.8	47.6	38.8	1
Md 62-3303	36.5	31.5	35.3	34.5	6
Wye	40.5	34.3	38.0	37.6	2
Md 65-3806	36.3	26.9	39.3	34.2	8
Md 65-1105	31.7	29.5	42.2	34.5	6
Md 65-1109	37.8	30.6	37.4	35.3	5
Md 66-1258	40.6	30.9	41.2	37.6	2
K 62-7221 (Columbus)	28.7	27.7	51.1	35.9	4
V 66-318	33.3	26.2	36.3	32.0	9

Table 5. Average Yields (Bu/A) of Soybean Strains of Maturity Groups IVs and V in Mid-Atlantic Region Tests when Planted after Barley at Two Locations.

Strain	Crumpton	Quantico	Average	Rank	Strain	Queenstown	Quantico	Average	Rank
Kent	30.3	42.9	36.6	4	York	65.2	48.4	56.8	3
Delmar	27.0	37.1	32.1	14	Hill	49.7	45.7	47.7	8
Md 62-3505	26.6	48.6	37.6	2	UD 66-7233	39.9	43.2	41.6	13
Md 62-3514	25.0	37.4	31.2	15	UD 66-7345	49.8	42.5	46.2	9
Md 62-3514-4	24.7	39.6	32.2	13	US 66-9826	41.0	45.4	43.2	12
Md 62-3514-10	26.8	40.6	33.7	11	V 68-616	36.8	37.1	37.0	14
Md 66-1056	25.4	34.8	30.1	16	V 68-952	50.7	52.9	51.8	6
Md 66-1057	32.3	41.5	36.9	3	V 68-984	52.7	38.2	45.5	10
Md 66-1155	29.6	41.6	35.6	7	V 68-1156	65.0	50.8	57.9	2
Md 66-1311	33.8	37.8	35.8	6	V 68-1171	45.4	60.5	53.0	5
Md 66-1327	28.8	43.2	36.0	5	V 68-1349	47.0	40.2	43.6	11
Md 66-1344	25.4	44.0	34.7	9	V 68-1356	58.8	49.2	54.0	4
Md 69-403	32.7	37.2	35.0	8	V 68-1358	46.4	54.3	50.4	7
Md 69-410	31.5	53.2	42.4	1	V 68-1365	63.6	59.4	61.5	1
UD 66-9373	29.0	38.0	33.5	12					
Md 70-100	26.4	42.2	34.3	10					
LSD_{05}	7.0	8.0				11.3	17.1		

Resistance to the Mexican Bean Beetle in Soybean Germplasm

J. A. Schillinger and P. E. Paz
Department of Agronomy

Purpose and Objectives

The Mexican bean beetle, Epilachna varivestis Muls. has become the most serious pest to soybean production on the Delmarva Peninsula. The York variety, the most popular variety in Maryland, is highly susceptible. The purpose of this study was to: (1) find resistant genotypes, (2) elucidate mechanisms of resistance, (3) determine levels of economic loss due to beetle finding, and (4) study inheritance of resistance.

Procedures

Over 150 soybean genotypes were evaluated for their degree of resistance to the Mexican bean beetle, at Quantico. They were planted on two dates - June 3 and July 14. Many of these entries were selected in 1970 tests and were therefore being verified for their level of resistance.

Loss of yield due to beetle feeding was also studied at Quantico. The soybean genotypes used included: York and Mack varieties; V 69-21 and V 69-156 breeding lines from Virginia; and a Plant Introduction, 89784. A split-plot design with insecticide as whole-plot and genotypes as sub-plots was used. Sevin was applied when the beetle population warranted controlling. It was applied as a spray at a rate of 1.7 Kg AI/Ha. Granular Furadan was applied at planting at the rate of 1.12 Kg AI/Ha. The insecticide treatments were randomized in each block, and the genotypes were randomized within each treatment.

Results

The feeding damage scores of the top 25 soybean genotypes and standard varieties Kent, Hill, and York.are presented in Table 1. V 69-21 was the outstanding source of resistance for the Mexican bean beetle. Other genotypes, mostly plant

introductions, were only slightly less resistant than V 69-21. The standard varieties all showed high scores of susceptibility with York suffering the worst feeding damage.

Significant yield reduction due to beetle feeding was observed in 1971 for the York soybean variety (Table 2). This was true despite the low population levels of the beetles in this study. Among the soybean genotypes tested, V 69-156 showed no adverse effect of beetle feeding. Its yields were higher in the non-sprayed plots (11% higher) than in the Furadan treated plots and only 2% less in the non-sprayed treatment than in the Sevin treatment.

Yield of the York variety was not only affected by the beetle, but also by the insecticide used. It produced 645 Kg/Ha more in the Furadan treatment than in the control plots, whereas in the Sevin plots York's yield was only 245 Kg/Ha greater than the control.

V 69-21 showed very little visual damage to beetle feeding, yet the yields in the Furadan and Sevin plots were 484 and 598 Kg/Ha higher than in control plots.

Summary

Differences in degree of feeding damage were observed in field trials at Quantico. York continued to be one of the most susceptible genotypes tested over the last three years. This was also reflected in yield reduction studies where York was significantly reduced in yield by beetle feeding.

Table 1. Feeding damage scores of soybean genotypes and standard varieties from studies conducted at Snow Hill (1970) and Quantico (1970 and 1971), Md.

Strain	Maturity Group	Snow Hill	Quantico		Mean Damage[1/]
		1970	1970	1971	
V 69-21	V	2.3	4.0	3.3	3.2
PI 90499-1	III	2.5		4.0	3.3
PI 86908	V	2.6		4.0	3.3
Md 69-17	IV	3.0		3.6	3.3
PI 246367	IV+			3.3	3.3
V 70-834	V			3.3	3.3
R 65-12	V			3.3	3.3
V 69-289	V	2.3	4.0	4.0	3.4
PI 243545	IV	2.3		4.5	3.4
PI 80837	IV	3.0		4.0	3.5
PI 157440	V		3.0	4.0	3.5
PI 229319	IV			3.5	3.5
Md 69-25	IV	3.0		4.0	3.5
PI 171434	IV	3.0		4.0	3.5
Md 69-19	IV-	3.0		4.0	3.5
V 70-283	V			3.6	3.6
PI 229314	IV	3.3		4.0	3.7
PI 90481	V		4.0	3.5	3.8
V 69-156	V	3.3	4.0	4.5	3.9
PI 157483	IV	3.0		5.0	4.0
PI 96089	V		5.0	3.3	4.2
V 70-282	V			4.3	4.3
R 68-105	V			4.3	4.3
PI 88820	V		5.0	4.0	4.5
PI 81777	III+	3.8		6.0	4.9
PI 89784	III+	6.0		6.2	6.1
D 64-4731	V	7.0	6.5	7.0	6.8
Kent	IV	7.3	7.5	6.5	7.1
Hill	V		7.5		7.5
York	V	7.5	8.0	7.5	7.6

1/ Damages scored on a 1 to 10 scale, each unit representing an estimated 10% damage.

Table 2. Yield (Kg/Ha) of 5 soybean strains as affected by Mexican bean beetle and under two different insecticide treatments. Quantico, Md. 1971.

Strain	Yield			Differences	
	C[1/]	F[2/]	S[3/]	C-F	C-S
V 69-156	3380.2 a	3003.8 a	3433.9 a[4/]	+376.4	-53.7
PI 89784	1740.5 a	1841.3 a	2069.8 a	-100.8	-329.3
Mack	3333.1 a	3346.6 a	3904.3 a	-13.5	-571.2
York	3205.4 a	3850.6 b	3447.4 a	-645.2	-242.0
V 69-21	3373.4 a	3857.3 a	3971.5 a	-483.9	-598.1

1/ Control (i.e. No insecticide)

2/ Furadan - Applied at the rate of 2.45 Kg/Ha.

3/ Sevin - Applied at the rate of 3.61 Kg/Ha.

4/ Treatments means followed by same letter at same strain not significantly different at the 5% level according to Duncan's Range Test.

CROPS & SOILS RESEARCH 1972

DEPARTMENT OF AGRONOMY
AGRICULTURAL EXPERIMENT STATION
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INTRODUCTION

Research Program in the Department of Agronomy

This report gives the research in progress in the Department of Agronomy. The research program in the Department includes the development of improved crop varieties and improved soil and crop management practices that result in more efficient production. Considerable emphasis is also given to research on soil and water conservation, soil and water use, soil-water pollution, air pollution and the disposal of waste materials.

The wide range of soils and 1.9 million acres of agronomic crops (corn, soybeans, tobacco, small grain, turfgrasses, hay, and pasture) grown in the state with a value of approximately 249 million dollars emphasize the size and importance of the research program in agronomy. To solve crops and soils problems research work is conducted at University Laboratories, on the outlying Experiment Station Farms, and cooperatively with farmers, golf course superintendents, and others throughout the state. The help and cooperation received from the many people in the state in carrying out our research program is greatly appreciated.

James R. Miller

Chairman, Department of Agronomy

R. L. Green

Acting Director, Maryland Agric. Expt. Sta.

Copper and Zinc in Coastal Plain Soils: I. Field accumulation from applications of manure; II. Movement as influenced by manures.

R. F. Korcak and J. H. Axley
Department of Agronomy

Purpose and Objectives

A limited survey of areas receiving heavy applications of chicken manure showed that copper was accumulating in these soils. However, the most extractable copper found to accumulate in the surface 6 inches of these soils was 44 lbs/A of copper. This quantity is apparently below the amounts applied in the manure. Scientific literature indicates that copper does not move in the soil, whereas zinc is more mobile. To study the differences between the amount of copper applied in manure and the amount found in soil, the following objectives were investigated:

1. Investigate the accumulation of copper and/or zinc in soils receiving applications of manure.

2. Determine the effect of chicken manure, hog manure and digested sewage sludge on the possible movement of copper and zinc in Mattapex silt loam and Sassafras sandy loam soil columns.

Field Accumulation from Applications of Manure

Procedure

Surface soil samples were taken from manured fields and adjacent non-manured fields from farms in Somerset and Worcester counties in Maryland. All the fields had received either chicken or hog manure applications. The sieved, air-dried samples were analyzed for extractable soil copper and zinc by use of 0.05N HCl plus 0.025N H_2SO_4, and total copper and zinc were determined in a nitric and perchloric acid digestate of 0.5 grams of air-dry soil.

Results

The extractable copper and zinc values of all soils studied were all below the initial toxic soil test level previously determined for copper or zinc (see Crops and Soil Research, 1971) to corn and soybeans on Coastal Plain soils (Table 1). However, increases in extractable copper and zinc were noted for most of the manured soils compared to non-manured samples of the same soil type (Table 1). Also total copper and zinc in the soils of manured fields compared to non-manured soils also reflected the effect of heavy manure applications on the increased copper and zinc status of these soils.

Summary

1. Samples collected from a few of the chicken and hog farming areas of the Eastern Shore of Maryland showed that there is accumulation of copper and zinc in these soils from chicken and hog manures. However, the amount of accumulation in these soils is less than might be expected from the many heavy applications of manure.

2. The accumulation noted in this investigation is not presently hazardous to the Maryland farmer. However, a monitoring of these soils should be conducted every ten years to assure that accumulation is not reaching toxic proportions.

Movement as Influenced by Manures

Procedure

In the laboratory, Sassafras sandy loam or Mattapex silt loam soil columns were studied.

Copper and zinc leaching studies were conducted using 12 inch Sassafras or Mattapex soil columns treated with chicken manure.

The chicken manure sample was obtained from the Hilton Bradford Farm, Worcester County, Maryland. Samples of hog manure were taken from the hog barn-holding tank at the University of Maryland Forage Research Farm, Clarkesville, Maryland. Digested sewage sludge was obtained from the Blue Plains Sewage Treatment Facility, Washington, D. C. The copper and zinc content of these materials is given in Table 2. The equal quantities of copper or zinc as manures were either surface applied to the soil or mixed in the soil.

Results

Using the 12-inch Sassafras soil columns, an average of 1.8% of the copper applied from the chicken manure was leached in $3\frac{1}{2}$ months with the addition of 10 inches of water (Table 3). These results should simulate field conditions and so it may be possible that in one year 6% of the added copper could leave a 12-inch depth of a Sassafras soil. Similarly, using 12-inch Mattapex soil columns, an average of 0.7% of the copper applied from the chicken manure was leached in 1 month with the addition of 10 inches of water (Table 4). If the soil was heavily burdened with copper, the amount of copper leached below the 12-inch depth would be increased even though the same amount of manure was used in both instances.

Only an average of 0.8% of the zinc from the manure was leached from the Sassafras soil. Under these conditions, this shows that zinc may be even a greater problem in soil than copper if the manures or sludges contain more zinc than copper as copper with manure moves more than twice as fast through the soil.

Summary

1. Fresh manures were observed to induce a greater amount of copper and zinc movement than digested sludge from both Sassafras and Mattapex soils in columns. This effect was more pronounced when the manure was mixed with the soil.

2. Under the conditions of these experiments, copper was found to be more mobile than zinc.

3. Prolonged addition of digested manures or sludges to soils may result in surface accumulation of copper and zinc.

Table 1. Extractable and Total Soil Cu and Zn for the Soils Used in the Investigation of Cu and Zn Accumulation in Soils.

Sample Location and Field Identification		Soil Cu		Soil Zn	
		Extractable*	Total**	Extractable*	Total**
		lbs/acre			
R. Richardson Farm	manured	0.8	16.0	4.2	20.2
Worcester Co., Md.	non-manured	0.2	24.0	1.4	7.2
L. Jones Farm	manured	4.4	20.0	5.2	24.0
Worcester Co., Md.	non-manured	0.6	16.0	0.6	13.2
H. Bradford Farm	manured	13.6	48.0	5.2	40.8
Worcester Co., Md.	non-manured	1.6	20.0	0.6	28.0
D. Bruning Farm	manured	3.4	16.0	3.4	36.4
Worcester Co., Md.	non-manured	0.4	8.0	0.8	18.4
Coons Farm	manured	8.2	56.0	19.6	75.2
Somerset Co., Md.	non-manured	1.0	12.0	7.2	40.4
Green Farm	manured	2.0	28.0	2.6	27.6
Somerset Co., Md.	non-manured	0.6	4.0	1.8	11.6
Pinto Farm	manured	4.4	44.0	29.6	100.8
Somerset Co., Md.	non-manured	1.0	16.0	2.6	17.6

* Extractable soil Cu and Zn as measured by the 0.05N HCl + 0.025N H_2SO_4 (weak acid extractant).

** Total soil Cu and Zn as measured by acid digestion of 0.5 g of soil.

Table 2. Copper and zinc content of the chicken manure, hog manure and digested sewage sludge used in the soil column experiments.

Material	Copper	Zinc
	lbs/Ton	lbs/Ton
Chicken Manure	0.832	0.492
Hog Manure	0.140	0.884
Sewage Sludge (digested)	1.708	0.684

Table 3. The influence of chicken manure on the amount of copper leached by the addition of 10 inches of water very slowly for a period of three and one-half months from 12-inch long Sassafras soil column.

Treatment	Replication	Cu Leached	Cu Applied
		-------lbs/acre--------	
manured	1	1.1	83.3
	2	1.3	83.3
	3	1.9	83.3
	average	1.6b*	
non-manured	1	0.0	0.0
	2	0.0	0.0
	3	0.0	0.0
	average	0.0a	

* Any two means which are not followed by the same letter are significantly different at the 5% level.

Table 4. The influence of chicken manure on the amount of copper leached by the addition of 10 inches of water very slowly for a period of one month from 12-inch long Mattapex soil columns.

Treatment	Replication	Cu Leached	Cu Applied
		lbs/acre	
manured	1	0.6	83.3
	2	0.3	83.3
	3	0.9	83.3
	average	0.6a*	
non-manured	1	0.0	0.0
	2	0.0	0.0
	3	0.0	0.0
	average	0.0b	

* Any two means which are not followed by the same letter are significantly different at the 5% level.

Plants Can Release Ammonia and Nitrogen to the Atmosphere

M. W. Meyer and J. H. Axley
Department of Agronomy

Purpose and Objectives

When 30 lbs/acre of nitrogen fertilizer was used on corn, only about 45% of the fertilizer nitrogen applied to Maryland corn soils was found in the stalk leaves and grain at harvest time. When 240 lbs. of nitrogen fertilizer was used, only 28% of the added nitrogen was present (see Md. Crop and Soil Research, 1969, page 150).

The problem of where the remaining nitrogen is, is one that has confounded scientists throughout the world. Of course, small quantities remain in the soil to be used by succeeding crops, but this is not the answer. Maryland scientists were able to follow the fertilizer nitrogen remaining in the soil by the use of the heavy isotope of nitrogen ^{15}N and they found that more fertilizer nitrogen vanished from the root zone of the corn soil than was found in the crop. By carefully checking the deeper layers of soil, they concluded that in general this nitrogen was not being carried away by water percolating through the Eastern Shore silty soils.

This led to the conclusion that microorganisms in the soil were turning nitrogen loose to the atmospheric nitrogen. This is now the accepted loss route for much of the fertilizer nitrogen not used by the corn plant. In fact, Maryland scientists confirmed this and have shown that appreciable quantities of this missing fertilizer nitrogen is lost from the soil in this manner.

In 1971 (see Md. Crop and Soil Research, 1971, page 11) Maryland scientists showed that plants could take ammonia from the air. The objective of this research was to determine if plants could not only take ammonia from the air but also give it off.

Procedures

The heavy isotope of nitrogen was used to tag the fertilizer nitrogen added to the soil in which the plants were grown. This allowed the scientists to follow the fertilizer as it passed into the root, up the stem, into the leaves and out into the air. As the stem and leaf portion of the plant were sealed in an air-tight container, any ammonia leaking out of the plant could be captured by passing the chamber air through a weak acid solution and, if ammonia was found in the acid, it could be proven that this ammonia came from the fertilizer by way of the plant because of the larger level of the heavy isotope of nitrogen in the captured ammonia.

Results

The experiment showed that aerial portions of plants can release ammonia to the atmosphere and this ammonia can come from the nitrogen fertilizer that was applied to the soil. The amount of ammonia nitrogen released in this manner was about one-fourth as much as a corn plant would take from normal atmosphere and retain in the plant. For the pigweed plant this uptake and release were about equal to that fixed from the atmosphere. Soybeans and pine tree seedlings were intermediate to these two extremes. Therefore, absorption of ammonia by plants generally predominates over release at most atmospheric ammonia concentrations and in the east where higher levels of ammonia predominate in the atmosphere, absorption would be much greater.

A second experiment using the same type of technique suggests that more ammonia is taken from the atmosphere by plants than is retained. Some of the ammonia taken up by plants is released back to the atmosphere in other forms than ammonia, probably as oxides of nitrogen or nitrogen gas. The percent of the absorbed atmospheric ammonia lost in this manner is large, possibly over twice as much, as was

retained by plants. These results suggest that plants themselves give off not only ammonia but other forms of nitrogen as well. Such a process is called denitrification. More needs to be known about such processes before their economic and environmental impact can be determined and the possibility of enhancing and utilizing these plant characteristics is considered.

Summary

Plants can release ammonia to an atmosphere low in ammonia. This released ammonia may have its source in the chemical fertilizer used on the crop. In these studies, this released ammonia was usually less than the ammonia taken up and retained from atmospheric ammonia.

Poultry Waste Water Irrigated Sods, a Possible Type of Treatment For Sod Production.

P. Snow and J. H. Axley
Department of Agronomy

Purpose and Objectives

Poultry processing waste water had been applied at two different rates, light (.47 inches/day) and heavy (.78 inches/day), on the following three grasses: Kentucky bluegrass, tall fescue, and penncross bent. The grasses were grown to compare their adaptability to applications of poultry waste water, their influence upon the infiltration of waste water into the soil and their ability to take up nutrients from the soil and waste water and finally their ability to form sod with good reestablishment characteristics when the sod is cut and layed on new soil. The objective of this experiment was to compare sod reestablishment of turf grasses grown under waste water irrigation to that of commercially grown sod.

Procedures

Marion bluegrass, penncross bent, and tall fescue were the turf grasses used. Grasses under the poultry waste system had been cut to maintain approximately a 6-inch height for maximum surface protection of the soil under sprinkler irrigation. Three weeks prior to cutting for sod, the grasses were mowed in several cuttings until a height of about $1\frac{1}{2}$ - 2 inches was obtained. Sod was cut the same day from a field irrigated with waste water at Cordova, Maryland and from commercial Marion bluegrass, penncross bent and tall fescue sod fields nearby on the Eastern Shore of Maryland. The sod was then taken to the University of Maryland Hopkins Research Farm in Montgomery County. The sod was placed in 1' x 2' frames which had hardware cloth across the bottom and arranged in a randomized block design. The sod was lifted at the end of 2 weeks after

the original laying of the sod on October 19, 1973, which was also the day it had been cut. A tripod, rope, pulley, and a scale were used to measure the tear force needed to pull the sod from the soil. It is assumed that the greater the tear force, the greater the amount of new root growth which can be related to the success of establishment of the sod. A second experiment of a randomized block design to be used for quality inspection was initiated at the same time the sod was placed. The quality of the sod was judged when the sod in the first experiment was lifted.

Results

During the three weeks prior to sod cutting when the grasses were trimmed from 6 inches to $1\frac{1}{2}$ - 2 inches, several observations were noted.

The bluegrass was found to have a heavy matted growth of roots. On the other hand, the penncross bent and tall fescue had a sparse mat due to a low plant population. The bluegrass when cut for sod was equal to or better in sod characteristics and ease of rolling than the commercial bluegrass sod. Penncross bent under this waste water management system when cut for sod would crumble somewhat when rolled. Weeds in the penncross bent grass were not a problem but surface root growth was not as dense as in the commercial bent grass sod. Tall fescue from the waste water area also had poor rolling characteristics, but was better than the bent grass from the waste water treatment area.

Table 1 indicates the pull force required to lift the different species. The root development of the bluegrass grown under the poultry waste was greater than the commercially grown sod. The heavy waste water treated sod had a poorer root development than the light rate indicating a suppression of reestablishment growth due to possibly a lack of root reserves. Penncross bent grass under the waste system had a higher tear force than the commercial penncross bent sod. The lift

force for tall fescue was less under the waste water system than from the commercial sod. This could possibly be attributed to a lower plant population than that found in the commercial sod.

Turf inspected for quality at the time of lifting gave comparable color, appearance, and growth between the bluegrass from the waste system and the commercial source. Bluegrass from the heavy rate of waste water irrigation gave a slightly poorer color and an inferior mat development when compared to bluegrass from the light rate or the commercial bluegrass. Penncross bent sod which had been grown under the waste water irrigation system seemed to be dying after the first week. After the second week, growth had increased and after three weeks it was comparable to commercial sod. Tall fescue under the waste water irrigation had growth equal to commercial sod, but the plant population and weeds resulted in lower quality turf.

Summary

1. Bluegrass (Marion) seems to be best adapted to the waste effluent of the grasses tested. Its higher rate of reestablishment over commercial Marion blue grass sod and its equal quality indicates it is well suited for these conditions.

2. Penncross bent sod when it had been grown under irrigation with poultry waste water had faster reestablishment rate of root growth than commercial sod, but its poorer quality may limit its use.

3. Tall fescue receiving poultry waste waters had poor root development compared to commercial sod. This was due to the bunch characteristics of tall fescue when it is given a high nutrient environment. Maybe, this grass should be avoided in this type of system. However, with shorter cutting heights $1\frac{1}{2}$ to 2 inches throughout the sod production period, a larger population of individual plants might be maintained and possibly in this manner an improved sod could be developed.

Table 1. Force required to lift a 1 ft. x 2 ft. section of turf from soil after the sod had been in place for 2 weeks.

Type of Grass Sod	Waste Water Irrigation Rate[1/]	Lift Force* lbs
Kentucky bluegrass (Marion)	light	18.3
Kentucky bluegrass (Marion)	heavy	14.7
Kentucky bluegrass (Marion commercial)	none	5.0
Penncross bent	light	8.7
Penncross bent (commercial)	none	6.0
Tall fescue	heavy	15.3
Tall fescue (commercial)	none	19.3

* Like sod grasses are comparable as to treatment. Different grasses are not comparable.

[1/] light = .47 inches/day; heavy = .78 inches/day (based on operation of 5 days per week)

Breeding for Disease Resistance in Maryland Tobacco, 1972

M. K. Aycock, Jr.
Department of Agronomy

Purpose and Objectives

A number of diseases attack tobacco grown in southern Maryland; therefore, a large part of the breeding program at the University of Maryland is concerned with disease resistance. At the present time the tobacco mosaic virus appears to be the most destructive disease and until recently, none of the varieties being grown had mosaic resistance. Other diseases which cause some loss in Maryland tobacco each year are black root rot (Thielaviopsis basicola), wildfire (Pseudomonas tabaci), black shank (Phytophthora parasitica var. nicotianae), and fusarium wilt (Fusarium oxysporum var. nicotianae). At present the tobacco breeding program is concerned with developing varieties with resistance to three diseases -- tobacco mosaic, black shank, and fusarium wilt.

Procedures

Breeding for Black Shank Resistance. The sources of resistance to black shank presently being used are from Md. 59 and Md. 609, two varieties released in 1965; and L8, a burley tobacco variety. Md. 59 and Md. 609 were developed by Dr. O. D. Morgan, and the source of black shank resistance was from Florida 301. L8 contains resistance from Nicotiana longiflora.

During January and February, 1972 a modification of a black shank screening procedure utilized at the University of Kentucky was used to screen 100 entries in the F_2 to F_8 generations. The procedure involved planting approximately 10 to 15 seeds of an entry in a vermiculite-filled 50 ml polypropylene centrifuge tube. About 4 weeks after seeding the seedlings were inoculated

with the black shank fungus. Two weeks after inoculation the entries were scored on above ground plant parts (leaves and stems) and the roots. A scoring system of 0, 1, 2, 3 and 4 was utilized for the leaves and stems with a score of 0 representing no symptoms of the disease and a score of 4 representing complete death of all seedlings. A similar system was used for rating the roots. A rating of 0 represented no symptoms (roots white) and 4 represented severe browning of the entire root system.

Breeding for Mosaic Resistance. During the summer of 1971, 56 breeding lines in the F_2 to the F_8 generations were screened for mosaic resistance in breeding nursery in the field. Each entry was represented by 28 plants. Just prior to flowering, plants were inoculated with the tobacco mosaic virus by rubbing the leaf with cheesecloth saturated in a solution of the virus. Approximately one week after inoculation, ratings were made on the number of resistant and susceptible plants in each entry. At the time of scoring the resistant plants exhibited small necrotic spots at the site of inoculation while the susceptible plants exhibited the characteristic mosaic pattern of dark and light green areas in the new growth. The necrotic spots of the resistant plants are due to a hypersensitive reaction of the leaf tissue to the virus. When the virus contacts the leaf cells, the cells die at such a rapid rate that the virus cannot spread.

Breeding for Fusarium Wilt Resistance. During the summer of 1971 plants of two breeding lines, M871 and M872, were transplanted to the fusarium wilt nursery in order to evaluate the level of resistance of these two lines. Just prior to transplanting, the roots were dipped in inoculum containing the fusarium wilt fungus. At maturity, seed from plants with a high level of resistance were obtained by bagging. Inoculation, transplanting, and bagging were done by Mr. H. A. Skoog of the USDA at Beltsville, who is in charge of the fusarium wilt nursery.

Results

Black Shank Resistance. The results of the screening procedure for black shank resistance are presented in Figure 1. Considerable variation was found among the entries for black shank resistance. A few entries appeared to have complete resistance while others were completely susceptible. From the leaf and stem scores, 61.0% of the entries received a score of 1.5 or better while 9.0% of the root scores fell within this same range. Entries with a leaf and stem score of 1.5 would probably have adequate resistance under field conditions in southern Maryland.

One reason for the wide variation among the entries for black shank resistance could be due to the nature of inheritance of the resistance. Resistance from the Florida 301 source is believed to be dependent upon two major genes and several modifiers; therefore, through breeding the ultimate objective is to capture the two major genes and accumulate as many of the modifiers as possible. Resistance from L8 is simply inherited and produces plants with a very high level of resistance.

Mosaic Resistance. The results of the tobacco mosaic screening procedure are shown in Figure 2. Resistance is determined by a single dominant gene; therefore, the plants fell into one of two classes -- resistant or susceptible. Screening results showed that all entries were resistant. For the entries, 53.0% appeared to be homozygous or true breeding and 47.0% were heterozygous or still segregating at the mosaic resistant locus.

Fusarium Wilt Resistance. Twenty-five plants of the two breeding lines, M871 and M872 were evaluated in the fusarium wilt nursery. All plants of both entries contained a good level of resistance and 17 plants of M871 and 13 plants of M872 were bagged in order to provide seed for further testing.

Summary

Breeding lines with resistance to black shank, tobacco mosaic, and fusarium wilt are being developed. Screening techniques which are relatively simple and reliable are being used in the greenhouse and summer breeding nursery. Lines with good resistance based on greenhouse and field results were advanced an additional generation in the field nursery during the summer. Selection for plant type and other desirable agronomic traits was done in the field nursery.

Some of the breeding lines which have good resistance and desirable plant types have been observed in preliminary field trials under replicated conditions.

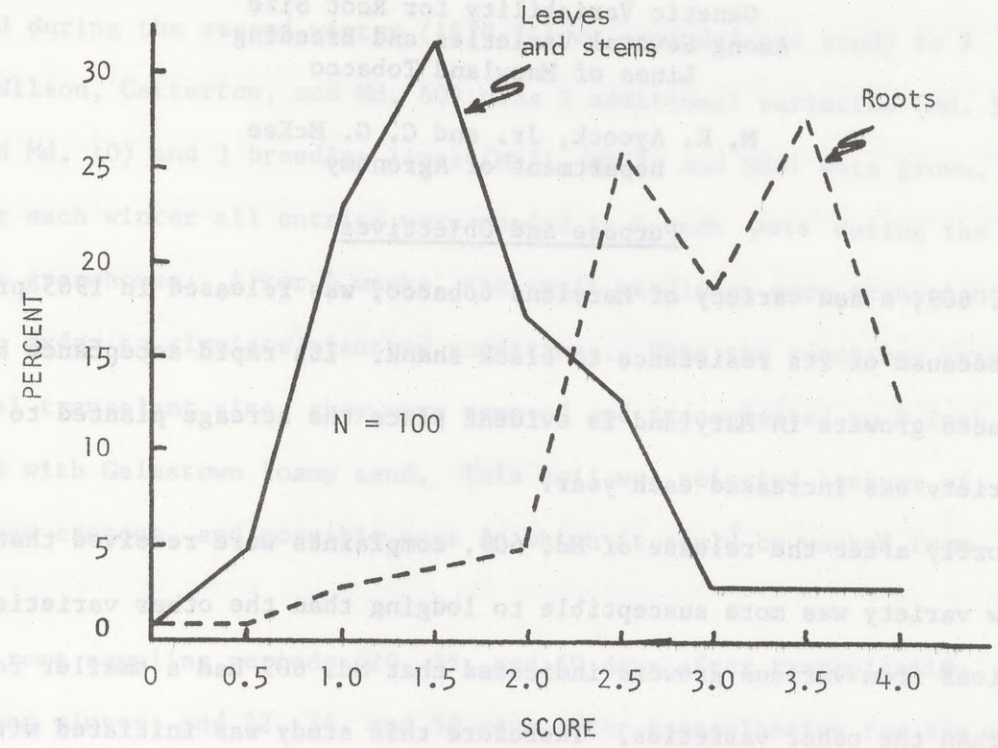

Figure 1. Frequency distribution of entries screened for black shank resistance; 0 = completely resistant and 4 = dead. (1972)

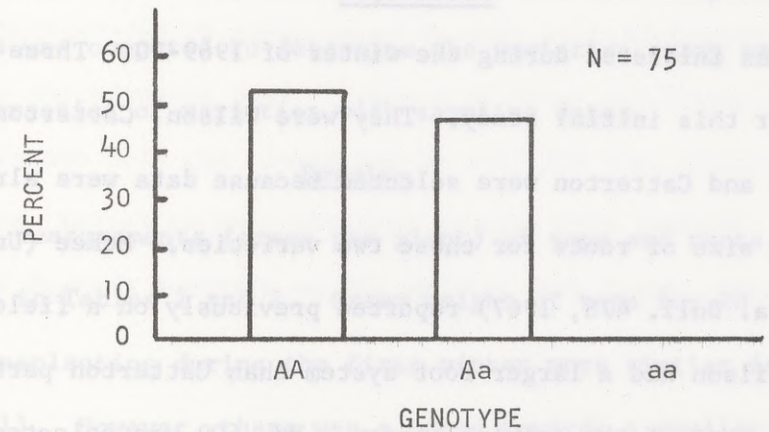

Figure 2. Percentage of resistant (AA) segregating (Aa), and susceptible (aa) genotypes screened for tobacco mosaic resistance, (1971)

Genetic Variability for Root Size Among Several Varieties and Breeding Lines of Maryland Tobacco

M. K. Aycock, Jr. and C. G. McKee
Department of Agronomy

Purpose and Objectives

Md. 609, a new variety of Maryland tobacco, was released in 1965 primarily because of its resistance to black shank. Its rapid acceptance by the tobacco growers in Maryland is evident since the acreage planted to this variety has increased each year.

Shortly after the release of Md. 609, complaints were received that this new variety was more susceptible to lodging than the other varieties. Suggestions from various growers indicated that Md. 609 had a smaller root system than the other varieties. Therefore this study was initiated with two objectives: (1) To determine if a simple, but reliable, method could be utilized in the greenhouse for measuring size of roots, and (2) To determine if differences in size of roots did exist among the various Maryland tobacco varieties.

Procedures

The study was initiated during the winter of 1969-70. Three varieties were selected for this initial study. They were Wilson, Catterton, and Md. 609. Wilson and Catterton were selected because data were already available on the size of roots for these two varieties. McKee (Univ. of Md. Agr. Exp. Sta. Bull. 478, 1967) reported previously on a field study and found that Wilson had a larger root system than Catterton particularly during the later part of the growing season. Md. 609 was selected because additional information was needed on its root system since it was suspected to be smaller than the other varieties.

Our root sampling procedure appeared to be satisfactory after the first winter, and during the second winter (1970-71) we expanded the study to 9 entries. Wilson, Catterton, and Md. 609 plus 3 additional varieties (Md. 59, Md. 64, and Md. 10) and 3 breeding lines (M871, M872, and M881 were grown.

During each winter all entries were seeded in 4-inch pots during the fall in the greenhouse. After 4 weeks, the small seedlings were transplanted to flats in order to simulate plantbed conditions. When the seedlings were about normal transplant size, they were removed and transplanted to 8-inch pots filled with Galestown loamy sand. This soil was selected because of its high sand content, and possible ease in which it could be washed from the roots.

Three root sampling periods (20, 35, and 50 days after transplanting for the first winter; and 22, 36, and 50 days after transplanting for the second winter) were established after transplanting to 8-inch pots. At each sampling, the soil was washed from the roots and separated from the tops at the soil line. Green weight measurements were obtained on both roots and tops. Each sampling date after transplanting was handled as a randomized complete block design with 6 replications. After the last sampling date, a combined analysis was computed to determine the variation among sampling dates, and possible interaction of varieties with sampling dates.

Results

Green weight measurements (grams per plant) of tops and roots for the 2 years are shown in Tables 1 and 2. Green weight of tops for 20, 35, and 50 days after transplanting during the first winter were similar for the 3 varieties (Table 1). However, there was a trend towards a smaller top weight for Md. 609. Root green weights for the 3 varieties were similar at 20 and 35 days after transplanting, but at 50 days, Md. 609 was significantly smaller

in root weight than Wilson. A similar difference was observed in the combined analysis over the 3 dates from transplanting.

For the second winter (1970-71), no significant variation was observed for top green weight among the 9 entries (Table 2). The root system for Wilson was considerably larger than the other entries at 22 days after transplanting. At 50 days, Wilson and M872 had significantly larger root systems than the other 7 entries. In the combined analysis, Wilson, M872, and Catterton had the largest root systems.

Summary

The growing of plants in 8-inch pots in the Galestown loamy sand soil appeared to be a satisfactory procedure for evaluating roots of the various varieties and breeding lines.

Significant variation was found among the various varieties for green weight of roots. This information will be useful in selecting parents for hybridization in future breeding work. Screening for size of roots could be done either during the segregating generations following a particular cross or in the F_7 or F_8 generations when the lines are essentially in a homozygous condition.

It must be recognized that size of roots alone do not control the amount of lodging which may occur in a plant. Root distribution and size of stalk, particularly near the base of the plant, may also contribute to this phenomenon. However root size is probably a major factor, and these results suggest that larger root systems may be obtained through breeding and selection.

Table 1. Green weight (g/pl) of tops and roots for 3 Maryland tobacco varieties, winter 1969-70.

Variety	Days after transplanting 20	35	50	Mean
		Tops		
Wilson	17.7a 1/	52.9a	102.0a	57.6a
Catterton	17.4a	47.8ab	109.1a	58.1a
Md. 609	12.5a	40.0 b	92.1a	48.2a
Mean	15.9	46.9	101.1	
		Roots		
Wilson	8.3a	32.3a	59.4a	33.3a
Catterton	7.1a	29.0a	50.7ab	28.9ab
Md. 609	4.4a	24.2a	40.8 b	23.1 b
Mean	6.6	28.5	50.3	

1/ Duncan's Multiple Range Test at the 5% level.

Table 2. Green weight (g/pl) of tops and roots for 9 Maryland tobacco varieties and breeding lines, winter 1970-71.

Variety	Days after transplanting 22	36	50	Mean
		Tops		
Wilson	27.2a 1/	50.8a	92.0a	56.7a
Catterton	23.8a	53.5a	79.4a	52.2a
Md. 59	18.2a	53.3a	83.1a	51.6a
Md. 609	17.6a	42.7a	87.6a	49.3a
Md. 64	19.4a	58.6a	68.7a	48.9a
Md. 10	20.8a	47.2a	75.6a	47.9a
M871	18.2a	48.0a	74.0a	46.7a
M872	18.8a	44.4a	79.8a	47.7a
M881	23.7a	48.5a	68.2a	46.8a
Mean	20.8	49.6	78.7	
		Roots		
Wilson	10.7a	25.8a	41.5a	26.0a
Catterton	7.4 bc	26.5a	29.8 b	21.2ab
Md. 59	6.0 c	22.4a	28.3 b	18.9 b
Md. 609	5.2 c	17.2a	28.4 b	16.9 b
Md. 64	5.8 c	24.4a	27.0 b	19.0 b
Md. 10	7.3 bc	22.2a	27.9 b	19.1 b
M871	5.8 c	23.4a	29.5 b	19.6 b
M872	6.2 bc	20.5a	37.3a	21.3ab
M881	8.3 b	23.4a	27.6 b	19.7 b
Mean	6.9	22.9	30.8	

1/ Duncan's Multiple Range Test at the 5% level.

Performance of Maryland Tobacco Varieties and Breeding Lines, 1971

M. K. Aycock, Jr.
Department of Agronomy

Purpose and Objectives

The Official Variety Test is the final phase of the breeding program and has three main objectives: (1) To obtain additional information on the varieties presently being grown by the majority of the tobacco farmers, (2) to evaluate advanced breeding lines which appear to have potential as a new variety, and (3) to provide a guide to southern Maryland tobacco farmers for use in choosing a variety to produce their best crop.

Procedures

Each year the variety tests are conducted at three locations with varying soil types. The tests are located on a Monmouth fine sandy loam at Upper Marlboro, Galestown loamy sand at Davidsonville, and Beltsville silt loam at Dentsville.

The 1971 test which is included in the present report contained four varieties and twelve breeding lines. Seven breeding lines in the test were developed by the USDA at Beltsville under the direction of H. A. Skoog. Five breeding lines were Agricultural Experiment Station entries with M871 and M872 from the Agronomy Department and B40, B76, and B347 from the Botany Department.

Four replications of a randomized complete block design were used at each location. Each plot consisted of one row of 23 competitive plants. The plots were three feet apart and plants spaced two feet apart in the plot. Twenty competitive plants per plot were cut at harvest.

The various agronomic and chemical characteristics measured and methods of data collection have been outlined by Aycock *et al.*, 1972, Md. Agr. Exp. Sta. Mis. Pub. 798.

Results

The average performance of the varieties and breeding lines compared at three locations in 1971 is shown in Table 1. Md. 64 was the highest yielding variety with 2088 pounds of cured leaf per acre. Md. 609 was the best quality variety with an average of $73.44 per hundredweight. Several breeding lines compared very favorably with the best varieties. J-70-1F-1 and J-70-101F-1 were similar to Md. 64 in yield and also gave a good dollar return per acre. M871 and M872 were slightly lower in yield than Md. 64, but produced a good quality leaf that was similar to Md. 609. Good yields and high quality for these two breeding lines resulted in a high dollar return per acre.

The varieties and breeding lines ranged from 1.42% (J-70-201F-1) to 2.28% (J-70-37F-1) for total alkaloids. Significant variation was noted also among most of the other agronomic and chemical traits measured. Several breeding lines compared very favorably with the standard varieties for these traits.

Summary

The variety testing program was conducted at three locations in 1971. Several breeding lines with multiple disease resistance appear to have a real potential as new varieties.

Table 1. Performance of Maryland tobacco varieties and breeding lines at three locations, 1971.

Variety or breeding line	Yield per acre (lbs.)	Value $/A	Value $/cwt	Plant height (in.)	Leaves per plant	Internode length (in.)	Days to flower	Total alkaloids (%)	Total nitrogen (%)	Duration of burn (sec./leaf)	Filling capacity (cc/g)
Md. 10	1792	1290	71.93	34.1	22.5	1.52	54.2	1.62	2.64	9.9	7.97
Md. 59	1655	1209	73.09	33.9	18.9	1.79	56.8	1.86	2.94	13.0	7.58
Md. 609	1753	1287	73.44	32.2	19.4	1.66	59.2	1.81	3.03	12.4	7.82
Md. 64	2088	1491	71.26	30.5	21.0	1.45	61.9	1.55	2.73	12.8	7.89
M871	1972	1447	73.31	33.6	19.6	1.72	56.2	1.54	2.96	8.8	7.38
M872	1982	1468	73.99	32.4	19.9	1.63	56.4	1.56	2.89	10.5	7.46
B40	1604	1167	72.79	34.6	19.6	1.76	56.8	1.87	2.87	10.8	7.78
B76	1703	1199	70.47	33.9	19.6	1.73	55.9	1.77	2.98	14.0	7.42
B347	1720	1248	72.63	35.4	19.2	1.85	51.7	1.79	2.88	12.4	7.75
J-70-1F-1	2023	1429	70.59	34.2	23.4	1.46	62.8	1.75	2.86	11.1	7.89
J-70-37F-1	1800	1309	72.56	33.6	19.7	1.71	56.2	2.28	3.10	7.1	7.65
J-70-39F-1	1804	1322	73.34	32.9	19.4	1.70	54.9	2.26	3.01	7.0	7.89
J-70-101F-1	2064	1463	70.70	32.1	19.6	1.64	58.1	1.74	2.81	10.2	7.41
J-70-201F-1	1963	1413	71.85	32.4	21.0	1.54	63.1	1.42	2.80	10.4	8.08
J-70-222F-1	1926	1370	71.08	34.5	20.1	1.72	58.3	1.61	2.96	15.5	7.52
J-70-231F-1	1957	1423	72.56	34.8	20.2	1.72	55.4	1.58	2.69	9.5	7.92
Mean	1863	1346	72.22	33.4	20.2	1.66	57.4	1.75	2.88	11.0	7.71
L.S.D. (0.05)	201	146	1.75	N.S.	1.5	0.08	3.4	0.30	N.S.	4.6	N.S.
(0.01)	271	197	2.36	N.S.	2.0	0.11	4.6	0.40	N.S.	N.S.	N.S.
C.V. (%)	7.9	8.3	1.8	6.7	6.0	5.0	3.8	14.4	10.0	28.9	10.1

Performance of Breeding Lines in the Preliminary Variety Test, 1972

M. K. Aycock, Jr.
Department of Agronomy

Purpose and Objectives

The initial phase of a breeding program is developmental. Following a desired cross or series of crosses, selection for superior lines is conducted for a number of segregating generations. As new lines reach homozygosity information concerning agronomic and chemical performance is needed. The preliminary variety test is the initial screening process for new breeding lines. Superior breeding lines in this test are then included in the Official Variety Test for further evaluation.

Procedures

In 1971 a group of near homozygous lines with resistance to black shank and/or tobacco mosaic were selected from the tobacco breeding nursery for yield and quality evaluations. These breeding lines were tested in 1972 at Upper Marlboro.

Forty-eight breeding lines and two standard varieties (Md. 609 and Md. 64) were included in the test. The experimental design was a randomized complete block with three replications.

Results

The performance of 48 breeding lines and two standard varieties is shown in Table 1. Entries 36, 47, and 48 had the highest yield and dollar return per acre of all entries in the test. Several entries were about equal to Md. 609 for dollars per hundredweight, but were higher than Md. 609 for yield. Considerable variation was observed among the other breed-

ing lines and in comparison with the standard varieties. The top breeding lines from this test will be advanced to the Official Variety Test, and also used as breeding material in future crosses.

Summary

The performance of several breeding lines was very good when compared with the standard varieties. These breeding lines will be advanced to the Official Variety Test, and also used as breeding material in future crosses.

Table 1. Performance of advanced breeding lines of Maryland tobacco in a preliminary variety trial at Upper Marlboro, Md., 1972.

Entry	Yield per acre (lb.)	Value		Days to flower	Total alkaloids (%)	Total nitrogen (%)
		$/A	$/cwt.			
1	1691	1271	75.02	59.0	1.98	2.73
2	1679	1321	78.62	58.7	2.06	2.83
3	1590	1205	75.75	59.0	1.77	3.09
4	1580	1231	77.87	56.0	1.97	3.00
5	1790	1416	79.22	52.7	1.81	3.01
6	1634	1305	79.85	56.0	1.60	2.98
7	1534	1214	79.07	55.0	1.85	2.97
8	1201	928	77.29	59.7	1.63	2.88
9	1337	1047	78.29	52.0	2.07	2.68
10	1733	1331	76.69	50.0	1.35	2.56
11	1761	1339	76.06	53.3	1.78	2.93
12	1794	1385	77.11	54.7	1.38	2.62
13	1806	1395	77.23	53.7	1.70	2.56
14	1841	1410	76.45	53.7	1.48	2.77
15	1520	1150	75.72	54.7	1.47	2.47
16	1694	1318	77.73	50.7	1.63	2.61
17	1753	1372	77.82	51.0	1.68	2.53
18	1781	1385	77.68	55.7	1.76	2.58
19	1820	1421	77.71	54.7	1.35	2.55
20	1688	1336	78.92	51.0	1.27	2.77
21	1703	1360	79.55	49.0	1.42	2.64
22	1746	1393	79.72	48.3	1.23	2.97
23	1524	1205	78.97	55.7	1.66	2.58
24	1757	1376	78.16	56.3	2.24	3.12
25	1522	1178	77.18	63.7	1.38	2.77
26	1679	1296	77.11	55.7	2.04	2.83
27	1518	1196	78.72	53.3	2.13	2.84
28	1774	1414	79.53	55.3	1.45	2.56
29	1296	982	75.86	55.7	1.24	2.43
30	1519	1199	78.73	56.3	1.96	2.58
31	1217	949	77.96	51.7	1.93	2.32
32	1638	1276	77.94	57.7	1.91	2.74
33	1658	1325	79.81	51.0	2.06	2.79
34	1750	1386	79.20	50.0	1.66	2.59
35	1678	1330	79.15	54.3	1.64	2.93
36	1911	1472	76.97	59.0	1.57	2.85
37	1789	1368	76.53	59.0	1.86	3.10
38	1472	1136	77.13	55.0	1.88	2.74
39	1297	1010	77.69	56.0	2.73	3.33
40	1628	1218	75.08	56.0	1.65	2.96
41	1440	1139	78.85	54.3	1.28	2.65
42	1598	1252	78.36	59.7	1.64	2.85
43	1527	1185	77.54	58.3	1.47	2.66
44	1800	1428	79.18	53.0	2.11	2.72

Table 1. Continued

Entry	Yield per acre (lb.)	Value $/A	Value $/cwt.	Days to flower	Total alkaloids (%)	Total nitrogen (%)
45	1808	1429	79.05	54.3	1.81	2.87
46	1838	1421	77.22	56.3	1.63	2.56
47	1942	1519	78.13	58.3	1.58	2.76
48	2197	1709	77.79	58.7	1.61	2.66
Md. 609	1744	1398	80.10	58.3	1.91	2.96
Md. 64	1520	1158	76.06	59.0	1.80	2.64
Mean	1654	1290	77.87	55.2	1.72	2.76
L.S.D. (5%)	434	N.S.	2.23	4.8	0.53	0.43
(1%)	N.S.	N.S.	2.96	6.4	0.71	N.S.
C.V. (%)	16.2	17.2	1.8	5.4	19.2	9.7

Variations Among Plant Selections of M871 and M872 Breeding Lines, 1972

M. K. Aycock, Jr.
Department of Agronomy

Purpose and Objectives

As breeding lines approach homozygosity, information concerning genetic variation among selected plants is needed in order to generate breeder seed from the best plant selections. This report describes variation found among two breeding lines, M871 and M872.

Procedures

Seed from 11 bagged plants of M871 and 15 bagged plants of M872 were used as source material for this study. The seed were obtained from plants that survived in the fusarium wilt nursery in 1971. The plants were bagged to insure self-pollination. Seed from the bagged plants were maintained separately and comprised 26 of the 28 total entries. The other 2 entries were the standard varieties, Md. 609 and Md. 64.

The 28 entries were grown in a randomized block design with 3 replications at the University of Maryland Tobacco Experimental Farm in 1972. Each plot consisted of 1 row of 20 plants spaced 2-feet apart. The plot spacing was 3 feet. Fifteen plants were harvested from each plot.

Results

Agronomic and chemical data for the 28 entries are shown in Table 1. Small but significant differences were found among the 28 entries for internode length, days to flower, and total alkaloids. No significant amount of variation was observed for any of the other traits measured.

Summary

Little genetic variation was found among the 11 M871 and 15 M872 entries. Based on these results, three traits (internode length, days to flower, and total alkaloids) should be considered in bulking seed for breeder seed stocks or advancing the breeding lines for another generation. Further improvement to these 2 breeding lines may be possible through outcrossing and selection for desirable traits during the segregating generations.

Table 1. Agronomic and chemical data for 26 plant selections (head-to-row) of M871 and M872 breeding lines and 2 standard varieties, 1972.

Entry	Yield (lbs/A)	Value		Plant height (cm)	Leaves per plant	Internode length (cm)	Days to flower	Total alkaloids (%)	Total nitrogen (%)
		$/A	$/cwt						
M871-1	1961	1542	78.52	80.9	17.6	4.59	53.0	1.51	2.75
M871-2	2167	1718	79.27	83.5	17.7	4.71	55.3	1.55	2.91
M871-3	1773	1389	78.18	80.1	17.1	4.67	57.0	1.40	2.83
M871-4	1919	1521	79.24	80.3	17.4	4.60	57.7	1.40	3.00
M871-5	2078	1660	79.90	83.2	17.5	4.74	56.3	1.53	2.92
M871-6	1842	1441	78.21	70.1	15.9	4.41	57.7	1.34	2.63
M871-7	2188	1757	80.20	81.3	18.3	4.43	55.7	1.58	3.18
M871-8	1979	1564	78.89	79.6	17.1	4.64	55.7	1.53	2.84
M871-9	1878	1478	78.47	76.0	16.6	4.57	56.7	1.38	2.72
M871-10	1975	1556	78.76	83.2	17.8	4.66	57.3	1.45	2.76
M871-11	1900	1512	79.30	79.8	17.4	4.59	56.0	1.71	3.13
M872-1	2067	1633	78.55	75.8	17.4	4.35	57.3	1.58	2.95
M872-2	2082	1652	79.35	81.2	17.9	4.53	57.7	1.57	3.02
M872-3	1831	1463	79.78	77.8	17.3	4.50	56.7	1.26	2.56
M872-4	1731	1380	79.33	73.0	16.5	4.39	57.0	1.28	2.57
M872-5	1939	1552	79.96	79.9	17.9	4.44	55.7	1.48	2.74
M872-6	1909	1501	78.34	75.9	17.2	4.35	57.3	1.44	2.57
M872-7	1994	1576	78.81	79.2	17.8	4.44	56.3	1.53	3.01
M872-8	1876	1459	77.50	71.8	16.6	4.29	56.7	1.44	2.75
M872-9	1925	1535	79.41	82.7	18.4	4.47	56.7	1.52	2.73
M872-10	1882	1493	79.36	73.0	16.5	4.44	58.3	1.48	2.97
M872-11	1905	1505	78.43	76.4	17.0	4.49	56.7	1.45	2.88
M872-12	1822	1432	78.49	78.6	17.1	4.58	57.0	1.52	3.00
M872-13	1854	1475	79.47	78.3	17.9	4.37	56.7	1.48	2.63
M872-14	1904	1511	79.04	73.5	17.3	4.23	57.3	1.52	2.80
M872-15	1962	1532	77.94	68.9	16.1	4.28	53.3	1.52	2.84

Table 1. Continued

Table 1. Continued

Entry	Yield (lbs/A)	Value $/A	Value $/cwt	Plant height (cm)	Leaves per plant	Internode length (cm)	Days to flower	Total alkaloids (%)	Total nitrogen (%)
Md. 609	1827	1451	79.44	84.4	18.5	4.54	56.3	1.89	3.21
Md. 64	1979	1511	76.37	72.5	18.8	3.85	53.7	1.71	2.75
Mean	1934	1529	78.88	77.9	17.4	4.47	56.4	1.50	2.84
L.S.D. (5%)	N.S.	N.S.	N.S.	N.S.	N.S.	0.39	2.1	0.25	N.S.
(1%)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	2.8	N.S.	N.S.
C.V. (%)	9.1	9.7	1.5	9.2	6.1	5.3	2.3	10.3	9.1

Nitrogen Fertilization of Small Grains

V. A. Bandel and C. E. Rivard
Department of Agronomy

Purpose and Objectives

Approximately 350,000 acres of small grain, including wheat, barley, rye, and oats are planted in Maryland each year. Of this acreage, approximately 100,000 acres is seeded primarily for use as a cover crop or pasture and is never harvested for grain. The remaining 250,000 acres are harvested for grain. Experience has shown that of the grain acreage in a normal year, at least 50% must be topdressed with from 20 to 100 lbs/A of nitrogen if top profits and maximum yields are to be realized.

Research results have shown that for maximum utilization of readily available nitrogen forms, such as ammonium nitrate and urea, the nitrogen should be topdressed on the small grain in late February or early March at about the time that growth starts in the spring. A major problem with topdressing at this time of the year is that fields are frequently wet or soft and difficult to cross with fertilizer spreading equipment. There would be a distinct advantage if a fertilizer material possessing slow release properties could be applied in the fall of the year, preferably at seeding time, and thus eliminate the traditional spring topdressing. Therefore, this test was conducted with its primary objective being to compare several soluble and slow release nitrogen materials applied to small grains in the fall or in the spring.

Procedure

This test was conducted on an Othello soil at the Poplar Hill Research Farm near Salisbury, Maryland in the fall of 1971 and the spring

of 1972. Urea and various solubility rates of sulfur-coated urea were either incorporated by disking in the fall at seeding time, topdressed in the fall at seeding time, or topdressed in the conventional manner in the spring. Blueboy wheat was seeded to the plots in the fall of 1971 and grain yields were harvested in July, 1972.

Results

The data indicate that in all cases, Blueboy wheat responded to at least 50 lbs N per acre and in some cases to 100 lbs of N per acre (Table 1). It made no difference whether the urea was disked in or topdressed in the fall at 50 or 100 lbs N/A or topdressed in the spring at 50 lbs N/A. But significantly higher yields (maximum yields for this test) were obtained where 100 lbs N/A were topdressed from urea in the spring of the year.

Sulfur-coated urea (SCU) at the "20" dissolution rate (SCU-20) and at 50 lbs N/A increased yields significantly under all methods and times of application compared to the check plot. One hundred lbs N did not significantly increase yields over 50 lbs N per acre. At the 50 lb rate, there was no difference between urea and SCU-20. With the exception of the spring application of 100 lbs N from urea, SCU-20 was no better nor worse than the regular urea.

SCU-30 did not demonstrate any particular advantage over SCU-20.

SCU-10 disked in in the fall was equivalent to the other forms of nitrogen at both nitrogen rates. There was some indication that yields were increased somewhat at the 100 lb/A rate, however, this yield was not significantly different from the yield produced by 100 lb/A N from urea disked in in the fall. Nor was it significantly different from 50 lbs/A N from urea topdressed in the spring.

Summary

It can be concluded from these tests that with the sulfur-coated urea materials presently available, there would be no advantage to applying these materials in preference to urea to small grains either in the fall or the spring. There was no advantage to incorporating the nitrogen carrier with the soil as compared to topdressing on the surface. Maximum yields in this test occurred where urea nitrogen had been top-dressed in the spring at 100 lbs N/A. It is hoped that with continuing research work, a satisfactory material can be developed that can be fall applied on small grains, thus eliminating or reducing the necessity of spring topdress applications on many fields.

Table 1. Grain yields of Blueboy wheat following treatment with variable nitrogen sources, rates, and times of application. 1972.

Source	Time	Method	Nitrogen Rate (lbs/A) 0	50	100
			----------Bu/A----------		
Urea	Fall	Disk	22.3 a	37.0 bc	42.6 bcde
Urea	Fall	T.D.	22.3 a	34.6 b	37.3 bc
Urea	Spring	T.D.	22.3 a	42.9 bcde	60.0 f
SCU_{20}	Fall	Disk	22.3 a	39.7 bcd	47.2 de
SCU_{20}	Fall	T.D.	22.3 a	39.9 bcd	43.3 bcde
SCU_{20}	Spring	T.D.	22.3 a	37.5 bc	46.7 cde
SCU_{30}	Fall	Disk	22.3 a	34.6 b	46.6 cde
SCU_{30}	Fall	T.D.	22.3 a		43.6 bcde
SCU_{10}	Fall	Disk	22.3 a	35.5 b	51.2 e

All numbers accompanied by the same letter are not significantly different at the 5% level.

Source and Rate of Nitrogen Application on Corn Grain Yields

V. A. Bandel and C. E. Rivard
Department of Agronomy

Purpose and Objectives

Of the three major plant nutrients required for crop production, nitrogen is the most costly. Nitrogen is also more susceptible to leaching and/or denitrification losses than the other plant nutrients. The nitrate form is extremely soluble and under reducing conditions is easily converted to the gaseous form, both of which are easily lost from the soil. The purpose of this project was to compare under field conditions several nitrogen sources of varying solubility. The primary objective was to measure subsequent nitrate movement following application of variable rates to corn on a light and a heavy textured soil. A secondary objective was to measure residual effects on corn yields the second season following nitrogen application.

Procedure

In 1971, nitrate of soda, sulfur-coated urea, and urea were compared as nitrogen sources for corn at two locations. Nitrogen was applied at rates of 0, 60, 120, 240, and 480 lbs/A. Soil types were a Bertie silt loam at the Wye Institute and a Galestown loamy sand at Poplar Hill. Grain yields were measured as well as nitrate levels in the soil profile beneath the plots.

In 1972, no additional nitrogen was applied to the plot area at either location. The plots received uniform applications of phosphate and potash only and were planted uniformly with Pioneer 3369A corn. Due to excessive rainfall, the corn plots at Wye Institute were drowned

out. The plots at Poplar Hill were observed in 1972 and grain yields were measured in an effort to detect differences in residual nitrogen carried over from the treatments applied the previous year.

Results

From the yield data presented in Table 1, it is obvious that residual nitrogen in the plots which had received 480 lbs N/A from the slowly available sulfur-coated urea in 1971 was sufficient to nearly double grain yields compared to other sources applied at the same or lower rates. Nitrogen at 240 lbs/A in 1971 from SCU increased yields by approximately 50 percent over the check. At 60 or 120 lbs N/A from SCU in 1971, there was no yield increase over the check.

Summary

Regardless of the rate of application there was apparently no N carry-over from urea or nitrate of soda the second year. Obviously, the sulfur-coated urea did not break down as fast as the soluble nitrogen sources and holds some promise of reducing soil nitrogen losses from leaching and volatilization. It is hoped that further research will produce a satisfactory slow-release nitrogen material which can be applied to corn in the spring on light sandy soils, thus eliminating necessary nitrogen sidedressing.

Table 1. Effect of nitrogen applied in 1971 from three sources at several rates on corn grain yields in 1972.

Nitrogen Source	Nitrogen rate (lb/A)					
	0	60	120	240	480	Ave.
	Bu/A					
Sulfur-coated	61.4 a	79.9 a	70.3 a	107.2 b	136.6 c	92.0
Nitrate of soda	61.4 a	58.8 a	62.6 a	72.5 a	77.7 a	66.1
Urea	61.4 a	64.5 a	63.1 a	75.0 a	71.7 a	66.8
Ave.	61.4	67.7	65.3	84.9	95.3	

Values accompanies by the same letter are not statistically different at the 5% level.

Sulfur Fertilization

V. A. Bandel
Department of Agronomy

Purpose and Objectives

For several years now there has been growing concern that sulfur deficiency may be developing on some Maryland soils. Although sulfur is recognized as an element essential for plant growth, thus far there has been no obvious need to apply it specifically as a fertilizer in Maryland. Sulfur is a macronutrient and like nitrogen, phosphorus, potassium, calcium and magnesium, it must be available in relatively large quantities for normal plant growth. Deficiencies in sulfur have been identified in certain parts of the United States and Canada as well as other parts of the world. But no sulfur deficiencies have yet been recognized or demonstrated in Maryland.

Sulfur deficiencies have been observed in such crops as cotton, tobacco, and bermudagrass in North Carolina, South Carolina, Georgia, and Florida. In Virginia, evidence of a sulfur deficiency in some forage crops has been detected. Thus, it is possible that some sulfur deficiency may already be present in Maryland.

Some of the factors responsible for the concern over possible low sulfur levels in Maryland soils include: 1) the trend toward use of higher analysis fertilizers which contain less sulfur as an impurity, 2) the trend away from the use of high sulfur fuels, thus reducing the amount of sulfur dioxide available as an atmospheric source of plant nutrient sulfur, and 3) higher crop yields, particularly in a monoculture situation, which places a heavier drain upon sulfur from the soil.

The objective of this project was to determine if a crop such as corn might respond to sulfur fertilization.

Procedure

In 1971, corn ear leaf samples were collected from twelve Maryland fields and analyzed for nitrogen and sulfur. Ear leaf sulfur levels ranged from 0.10% to 0.27%. The N/S ratios ranged from 8.5 to 28.0. For ruminants a N/S ratio of 15/1 was long considered adequate. But more recent work has indicated a narrower ratio such as 9.5:1 to 10:1 leads to improved nitrogen utilization by ruminants. It has also been reported that cattle in their diets require between 0.15 and 0.20% S in the total ration dry matter. The sulfur content values and N/S ratio values obtained in 1971 indicated that some areas of sulfur deficiency may already have occurred in Maryland.

Therefore, in 1972, field tests were established at eleven locations throughout Maryland. The test locations were on fields which had been reported to have received little or no sulfur fertilization for several years. Sulfur was applied at the rate of 50 lb/A of elemental sulfur from potassium sulfate and gypsum in the early spring. Data was collected from nine of the test plots. Corn ear leaf samples were collected at tasselling time and analyzed for N and S. Grain yields were harvested in September from eight locations and silage yields were taken at one location.

Results

The results are given in Tables 1, 2, 3 and 4. Obviously, no crop response to sulfur fertilization occurred in 1972. There is some probability that the excessive amount of rainfall most of these plots were exposed to in the spring and early summer may have been partially responsible for the lack of response. Stands were poor at some locations due to water standing on the fields for excessive periods of time. Poor stands were sometimes further aggravated by increased growth of weeds. There may also have been some nutrient losses due to leaching and/or volatilization.

Summary

The response of corn to applications of sulfur was evaluated at nine locations in Maryland. There was no increase in the yield of corn with the application of sulfur from potassium sulfate or gypsum. There was also no increase in the sulfur content of the corn ear leaves when the soils were treated with 50 lbs per acre of sulfur.

Table 1. Yield response of corn to sulfur fertilization. 1972.

Location	Check[1/]	Potassium Sulfate[2/]	Gypsum[2/]
	----------Bu/A[3/]----------		
Cecil	114.4	111.2	115.7
Kent	64.5	46.8	65.5
Worcester #1	109.6	114.8	108.1
Dorchester #1	143.1	135.1	151.6
Dorchester #2	145.6	144.6	156.3
Talbot	128.0	119.8	126.3
Wicomico	108.4	110.8	96.9
Average	116.2	111.9	117.2
	----------T/A[3/]----------		
Allegany	9.2	9.8	9.8

1/ No sulfur applied to check plots.
2/ Sulfur applied at 50 lb/A of S.
3/ Grain @ 15.5% H_2O, Silage @ 70% H_2O.

Table 2. Sulfur content of corn ear leaves treated with two rates and two sources of sulfur fertilizer, 1972.

Location	Check[1/]	Potassium Sulfate[2/]	Gypsum[2/]
	----------% S----------		
Cecil	0.18	0.18	0.18
Kent	0.12	0.12	0.16
Worcester #1	0.18	0.18	0.18
Worcester #2	0.12	0.11	0.11
Dorchester #1	0.16	0.17	0.17
Dorchester #2	0.14	0.14	0.14
Talbot	0.15	0.20	0.18
Wicomico	0.18	0.18	0.17
Allegany	0.07	0.07	0.08
Average	0.15	0.15	0.15

1/ No sulfur applied to check plots.
2/ Sulfur applied at 50 lb/A of S.

Table 3. Nitrogen content of corn ear leaves treated with two rates and two sources of sulfur fertilizer. 1972.

Location	Check[1/]	Potassium Sulfate[2/]	Gypsum[2/]
	----------% N----------		
Cecil	2.8	2.8	2.8
Kent	2.2	1.8	2.1
Worcester #1	2.8	2.8	2.9
Worcester #2	2.8	2.9	2.9
Dorchester #1	2.7	2.6	2.9
Dorchester #2	2.8	2.7	2.6
Talbot	2.7	2.7	2.5
Wicomico	2.7	2.9	3.1
Allegany	1.5	1.6	1.7
Average	2.6	2.5	2.6

1/ No sulfur applied to check plots.
2/ Sulfur applied at 50 lbs/A of S.

Table 4. Nitrogen to sulfur ratio of corn ear leaves treated with two rates and two sources of sulfur fertilizer. 1972.

Location	Check[1/]	Potassium Sulfate[2/]	Gypsum[2/]
	----------N/S----------		
Cecil	15.9	16.3	15.7
Kent	18.3	15.2	14.6
Worcester #1	16.0	16.1	16.1
Worcester #2	22.6	26.3	27.8
Dorchester #1	16.8	15.6	16.9
Dorchester #2	20.0	19.6	18.4
Talbot	17.9	14.1	14.6
Wicomico	15.0	16.7	18.8
Allegany	23.1	21.7	22.4
Average	18.4	18.0	18.4

1/ No sulfur applied to check plots.
2/ Sulfur applied at 50 lb/A of S.

The Response of Corn to Fall Versus Spring Plowing and Fertilization When Treated with Urea and Nitrate of Soda

V. A. Bandel
Department of Agronomy

Purpose and Objectives

When this project was initiated several years ago the main concern was whether or not fall nitrogen fertilization of corn would be economical. Today, the concern is not so much fertilizer economics but environmental protection from the effects of possible nitrogen fertilizer loss through leaching. The objectives of this experiment are to compare the effects of the following variables upon corn yields and nutrient recovery:

1. Fall vs. spring plow-down of urea and nitrate of soda.
2. Fall vs. spring plowing.
3. Several rates of urea plow-down in the fall and in the spring.
4. Nitrate of soda vs. urea plow-down in the fall and in the spring.

Procedure

In 1972, this project was conducted at two locations - 1. Wye Institute, Queenstown, and 2. Worcester Vocational Center, Snow Hill. The soil type at each location respectively was Bertie silt loam and Mattapeake loam. Two sources of nitrogen, urea and nitrate of soda, in a complete fertilizer were broadcast and plowed-down in a replicated split-plot design. The subplots within each main plot included urea at rates of 0, 55, 110, and 165 lbs. N/A, and nitrate of soda at 110 lbs. N/A. Phosphate (P_2O_5) and Potash (K_2O) were applied uniformly to all plots at a rate of 120 lbs/A. All plots received a small uniform starter fertilizer application in the row at the time of planting.

The fall-applied fertilizer was broadcast soon after the previous corn crop had been harvested. This normally occurred in late October or early November. The treatments were not plowed down in the fall of 1971, however, due to exceptionally wet conditions. Instead, the fall fertilizer applications were disced in. The spring fertilizer was applied in early March as soon as the soil was in shape to plow. All plots, both fall and spring treatments, were plowed in the spring.

Results

The results in 1972 reflect the efforts of four consecutive years of similar treatments on the same plots. The one exception being that no fall plowing was done in the fall of 1971. The grain yields obtained at the two locations in 1972 are given in Table 1. In contrast to previous years, there was a significant difference in yields due to fall and spring nitrogen applications. In previous years, no significant yield response to fall and spring nitrogen applications occurred, apparently due to the masking effect of residual soil nitrogen and an interaction between time of plowing and nitrogen rate. In 1972, average yields increased from 83.2 to 111.5 bu/A at the Worcester Vocational Center and from 62.6 to 98.1 bu/A at the Wye Institute due to fall and spring applications respectively.

At both locations a significant response to nitrogen rate occurred. At Worcester Vocational Center on the Mattapeake soil maximum yields occurred following application of 55 lbs/A of nitrogen. On the Bertie soil at Wye Institute, there was a trend which indicated maximum yields occurred between 110 and 165 lbs/A of nitrogen.

Summary

Based upon a summary of data collected in this project from 1964 to 1972, the following conclusions were reached:

1. Nitrogen applied in the fall to fallow land is subject to serious leaching and/or volatilization losses and is not, therefore, a recommended practice.

2. Occasional yield advantages to fall plowing occurred. The yield differences favoring fall plowing may have been caused by 1) increased release of soil organic nitrogen, or 2) a breakdown of soil structure often associated with early spring tillage. But this response was not consistant and could be overcome by application of appropriate rates of N in the spring. Fall plowing is not recommended where soil erosion is a problem.

3. Some Maryland soils contain large amounts of residual soil nitrogen. Under favorable conditions, there may be sufficient available N in the soil to nearly meet crop requirements. But this N source is unpredictable and cannot be relied upon to regularly supply a major portion of the plant's N requirements.

4. Under the conditions of these tests nitrogen from urea was no more stable in the soil when fall applied than the nitrate form found in nitrate of soda.

5. Readily available nitrogen, regardless of source, should not be plowed down in the fall for a crop to be grown the following season.

Table 1. Grain yield response of corn on a Mattapeake loam in Worcester County and on a Bertie silt loam at Wye Institute to various levels of fall and spring applied nitrogen in 1972.

Time of Application	N lbs/A					
	0	55	110	165	110 1/	Ave.
	Bu/A (15.5% H_2O)					
Worcester County						
Fall	62.3	78.1	84.5	95.8	95.4	83.2*
Spring	75.8	124.4	118.8	123.1	115.6	111.5
Ave.	69.0	101.2	101.7	109.5	105.5	
LSD .05 = 19.0 Bu						
Wye Institute						
Fall	37.5	49.6	74.1	75.0	76.8	62.6*
Spring	40.9	76.4	96.1	143.9	133.4	98.1
Ave.	39.2	63.0	85.1	109.5	105.1	
LSD .05 = 31.0 Bu						

* Means for time of application were significant at the 5% level.

1/ Nitrogen source nitrate of soda this treatment only. Nitrogen from urea all other treatments.

Zinc Fertilization of Corn

V. A. Bandel and C. E. Rivard
Department of Agronomy

Purpose and Objectives

Zinc deficiency in corn is not a serious problem in Maryland as far as total acreage affected is concerned. However, zinc deficiency can be a serious problem in certain localized areas of relatively small acreages. For these farmers, yields are often reduced to the point where it is not profitable to grow a crop. Because of the seriousness of the problem when it does occur, and the publicity given to these few cases, many growers have been made aware of zinc deficiency in corn and are on the lookout for the problem in their own fields. Therefore, it is critical that we learn how to correct this problem with the proper zinc fertilizer recommendations when a zinc deficiency problem is detected. The objectives of this work were to compare the effectiveness of several rates of row applied zinc on corn yields and zinc content when applied to several different soil types.

Procedure

In 1972, tests on corn were conducted at three locations - two in Worcester County and one in Howard County. In Worcester County, sites were selected which were known to be low in zinc and had previously exhibited corn zinc deficiency symptoms. In Howard County a site was selected on which a soil test indicated a satisfactory zinc level and on which a zinc deficiency problem had not been detected previously. Soil test information for each site is given in Table 1.

To establish the plots, a 2-row International corn planter was equipped with an 8-hose squeeze pump. This apparatus was used to apply an 11-37-0 fertilizer solution containing various amounts of zinc.

The fertilizer solution was placed approximately 2 inches to the side and 2 inches below the seed at planting time. Pioneer variety 3369A seed corn was used at all three locations. Zinc from zinc oxide was applied at five rates at two locations and four rates at the third location. Zinc oxide was applied at 1, 2, 4, 8 and 12 lbs. Zn/A. At a rate of 400 lbs/A of 11-37-0, this required solutions containing 0.25, 0.50, 1, 2 and 3% zinc. The zinc oxide was mixed into a small amount of 11-37-0 solution, making a slurry in a small pail using a paint stirrer on a 1/4 inch electric drill. This slurry was then added to a carboy containing 11-37-0 fertilizer solution. This mixture was mixed by hand in the carboy and then placed on the planter.

Two other treatments included were a check which received no zinc and a Geigy chelated zinc which was applied at a rate of 0.3 lb. of zinc per acre. One problem encountered was that the zinc oxide/11-37-0 solution settled out on the 120 mile trip from College Park to Salisbury. The only solutions which did not settle out were the chelate and the 0.25 and 0.50% Zn solutions. All other solutions were re-suspended later by dissolving the zinc in hot water.

In the field, four carboys containing various levels of zinc were placed on the planter at one time. Two pump hoses, one for each row, were used for each different solution. It was found that it was necessary to place weights on the ends of the suction hoses to keep them submerged at all times. The delivery hoses stayed in the carboy with the suction hoses whenever a treatment was not being applied. Except for the settling-out problem and the suction hoses floating to the surface of the 11-37-0 solution, this method of establishing zinc treatments in corn plots worked very well. It is anticipated that in the future to minimize the ZnO settling-out problem, the total volume of material will be adjusted

so that zinc oxide concentrations in 11-37-0 will not much exceed 2% zinc.

Observations of plant growth were made during the season. Ear leaf samples were collected at the tasselling stage for determination of zinc content and grain yields were harvested in September.

Results

Zinc response in corn normally occurs in the early stages of growth. By the time the corn reaches tasselling stage, zinc deficiency problems quite often have disappeared. Of the three tests in 1972, the only location which exhibited early response to zinc was the Mattapeake sandy loam at the Worcester Vocational Center. However, the treatments were not given a fair chance to indicate whether or not a yield response would occur due to the development of nitrogen deficiency problems toward the end of the season. Because of the light texture of this soil and the extremely heavy amount of rainfall which occurred in 1972, much of the nitrogen leached out of the soil, and nitrogen deficiency restricted yields.

Ear leaf samples were collected from all plots at the tasselling stage. The zinc content of these samples are given in Table 2. Differences in zinc content were not statistically significant at the Worcester Vocational Center (Mattapeake soil) in spite of the fact that an early response to zinc was noted. Also, even though no response to zinc treatment was detected visually on the Othello soil at the Cherrix farm, zinc uptake in the ear leaves was statistically significant at the 0.5% level. Early visual differences in plant growth and zinc deficiency symptoms on the Mattapeake soil indicated that 0.3 lb/A of zinc as the chelate or 2 lb/A of zinc as zinc oxide reduced the severity of zinc deficiency in corn compared to the check. However, these lower

rates did not completely correct the zinc deficiency problem. With 4, 8 and 12 lbs Zn/A in the row as zinc oxide, the plants appeared normal. These differences in color and plant height due to zinc treatment were obvious until the plants were approximately waist high, then disappeared.

Grain yields were harvested from the plots in the fall of 1972 and are presented in Table 3. Differences between means were significant at the 2.5% level on the Mattapeake soil at the Worcester Vocational Center. However, there were no trends, and yield differences were due largely to soil variability which was accentuated on the light sandy soil by the excessive amount of rainfall received during the growing season. Yield differences were significant at the 10% level on the Othello soil at the Cherrix farm. There was a slight trend indicating maximum yields occurred following application of 2 or more pounds of zinc as zinc oxide in the row. Yields were not significantly different due to zinc treatments on the Chester soil at the Forage Research Farm.

Summary

It can be concluded from the zinc work conducted in 1972 that where zinc deficiency problems occur in corn, it is possible to correct the deficiency by the application of approximately 4 lbs/A of zinc as zinc oxide in the row. Field observations early in the season indicated that zinc chelate at 0.3 lb/A of Zn and zinc oxide at less than 4 lbs/A of Zn will not correct zinc deficiency problems in corn, at least under the conditions encountered during the 1972 growing season. This work will be continued in 1973 with some new locations being established and the old ones being observed for residual carry-over effects in the 1973 crop.

Table 1. Location, soil type, and fertility level of 1972 zinc test sites.

County	Soil Type	pH	P_2O_5		Zinc
			lb/A	Range	lb/A
Worcester	Mattapeake fine sandy loam	7.0	150	H	1.0
Worcester	Othello silt loam	6.7	100	M	0.6
Howard	Chester silt loam	6.7	115	M	2.4

M = medium, H = high

Table 2. Zinc content of corn ear leaf samples. 1972.

Soil Type	Row Zinc (lbs/A)							Significance Level
	0	0.3	1	2	4	8	12	
	ppm							%
Mattapeake	11	10	--	11	12	14	12	N.S.
Othello	9	9	9	10	11	13	15	0.5
Chester	13	11	12	12	12	12	12	N.S.

Table 3. Grain yield response of corn to variable zinc treatments. 1972.

Soil Type	Row Zinc (lbs/A)							Significance Level
	0	0.3	1	2	4	8	12	
	Bu/A (14.5% H_2O)							%
Mattapeake	100.8	86.9	---	81.4	104.7	102.4	95.5	2.5
Othello	119.2	117.8	114.9	127.6	127.8	139.7	125.1	10.0
Chester	136.5	136.8	140.9	133.7	140.6	138.6	151.1	N.S.

Effect of Soil Factors on the Distribution of *Rhizobium japonicum* Serogroups

D. F. Bezdicek and D. C. Wolf
Department of Agronomy

Purpose and Objectives

Serological techniques can be used to study ecological factors influencing distribution of rhizobia.

Studies concerning the ecology of *R. japonicum* in soybeans are often conducted on a wide variety of soil type and climatic conditions. However, each soil type has its own characteristics as manifested by textural, structural, morphological, and chemical features. Superimposed upon these features are other ecological factors imposed by man. These include cultivation, difference in fertilization, liming, and cultural practices used by the farmer. Rhizobia populations and nodulation are markedly influenced by liming and N fertilization of soybeans and previous crops.

The objectives of this study were to ascertain the serological distribution and soil factors influencing the distribution within two specific soil types, Matapeake silt loam and Sassafras sandy loam, common to Maryland's Eastern Peninsula. Of particular interest was the serological distribution in relation to the N status of the soil.

Procedures

Nineteen sites were selected from two Maryland Eastern Shore counties, Dorchester and Somerset, in 1968. Fields were comprised of two main soil types: Sassafras sandy loam (10 sites) and Matapeake silt loam (9 sites). A representative plot area of 20 by 20 ft was designated for sampling and yield determination.

Previous cropping history included a corn-soybean rotation of average or above yield. Soybeans of 'Kent' cultivar were planted by conventional means. No inoculum was used since an established population of Rhizobium was present.

Soil samples from the Ap and B horizons were taken just prior to flowering. Soil samples from the Ap were again taken at pod fill. Soil samples were air dried and analyzed for the following, using routine tests: pH, extractable P, exchangeable K and Mg, and organic matter (OM) by procedures used in the University of Maryland Soil Testing Laboratory. In addition, soils were analyzed for KCl-extractable NH_4^+ and NO_3^- by the MgO-steam distillation procedure of Bremner. Soil organic N was subsequently determined on the same sample (10g) by the procedure of Stanford and DeMar, where four distillable fractions were obtained after initially autoclaving in 0.01M $CaCl_2$ overnight.

Fresh nodule samples were taken at pod fill from two 3-m sections of row at each site, combined, and placed in vials at 0C. Fifteen nodules from each site were selected at random and typed serologically across 16 Beltsville antisera by the quick method of Means et al. Forty-five nodules were later typed across the seven most predominant serogroups, 46, 76, 94, 110, 122, 123, and 125 found in the preliminary screening. Nodules not reacting with the above serogroups were placed into a composite category (serogroups 4, 6, 31, 38, 112, 124, 135, and negative). Soybean yield was determined on the basis of two 6-m rows.

Serological distribution within soil types was compared using the Chi square statistic with the mean of each serogroup taken as expected. All soil and serological data were statistically analyzed by linear correlation with the Univac 1108 computer. (Computer time for this project was supported by the University of Maryland Computer Science Center.)

Results

Soil analyses for the two soil types are shown in Table 1. In general, higher values of organic matter (OM) and of several organic N (Org N) fractions were obtained for the heavier-textured Matapeake. The Sassafras was generally higher in soil P.

Serological distribution of serogroups for the two soil types studied is shown in Table 2. Sixteen antisera showed positive reaction to nodules from each soil type. However, for statistical purposes, the seven most frequently detected serogroups and the composite are presented. Serogroup 122 occupied the largest proportion for both soil types although it made up less than 20% of the total. This is in contrast to other studies where one or two serogroups dominated the serological distribution. Large variation in serogroup distribution between sites was obtained. Chi square values were sufficiently large to suggest that different populations were sampled within each soil type.

Correlation of serogroups with numerous soil tests for the Sassafras soil also is shown in Table 2. Serogroups 46, 94, and 122 were not correlated with any soil parameters studied. Only one serogroup, 76, was positively related to soil K. Serogroup 110 showed a positive correlation with OM, several Org N fractions, and extractable NH_4^+ and NO_3^-. Thus, it appears that strains within serogroup 110 persist under soils of high N availability and can infect a greater number of root sites under such conditions.

Serogroup 123, while negatively related to Org N, was positively correlated with the pH of both the Ap and subsoil horizons, and with soil Mg. This indicates that this serogroup favors a neutral soil environment.

Serological correlations for Matapeake silt loam are also shown in Table 2. Serogroup 46 showed a positive relation to 76 while being nega-

tively related to soil P, whereas 76 and soil K were positively correlated for the Sassafras soil. Caution must be exercised in evaluation of correlations of soil parameters since although statistically they are considered independent, they are in reality, interdependent in the soil system. Soil pH may influence soil test values of P and K. The negative correlation of soil P with serogroup 76 is not likely due to toxicity of P since the soil test average (64 ppm) for Matapeake is lower than that for Sassafras (93 ppm) as shown in Table 1. Both serogroups, 94 and 122, were positively related to soil N although 94 was correlated with two Org N fractions and exchangeable NH_4^+. Serogroups 110 and 125 were not correlated with any soil parameters. Serogroup 123 was negatively correlated with Org N IV which is consistent with that obtained for the Sassafras soil.

Summary

From experiments under field conditions, it was concluded that Beltsville serogroup 110 was positively correlated with several organic N fractions, soil NH_4^+, and soil NO_3^- for the Sassafras soil. Serogroup 123 showed a positive correlation with soil pH and exchangeable Mg. When the Matapeake soil was considered, serogroup 94 was positively correlated with the soil N status much like 110 was for the Sassafras soil.

Table 1. Soybean yield and soil analyses determined for Sassafras sandy loam and Matapeake silt loam.

	Soil			
	Sassafras		Matapeake	
	Range	Mean	Range	Mean
Soybean yield, bu/a	28.46-39.34	34.27	28.61-57.51	38.44
pH_{Ap}	5.2-6.9	5.9	5.1-6.8	5.7
pH_{B}	5.2-6.9	6.1	5.2-6.1	5.6
Mg, ppm	3-112	59	18-112	92
P, ppm	23-153	93	17-153	64
K, ppm	37-174	80	25-174	88
OM, %	0.5-1.3	1.0	1.1-2.6	1.8
B, ppm	0.06-0.34	0.19	0.06-0.44	0.28
Mn, ppm	11-40	28	7-45	28
Org NI, ppm*	6.2-37.3	14.6	9.8-36.9	18.4
Org NII, ppm*	4.8-12.0	7.1	5.6-38.9	15.0
Org NIII, ppm*	4.0-22.5	11.1	1.2-13.1	8.3
OrgNIV, ppm*	1.1-48.4	20.4	2.8-38.3	14.5
Org NV, ppm*	174-655	391	112-820	590
NH_4^+-N, ppm	0-0.8	0.08	0-2.4	0.45
NO_3^--N, ppm	0-2.4	0.34	1.0-17.4	4.1

* Organic N. (Org N): I - 1st distillable fraction after $CaCl_2$ extration; II - 2nd fraction after acidification; III - amino fraction; IV - unidentified; V - total N less fractions I-V.

Table 2. Serogroup distribution and correlations obtained between Beltsville serological groups (*R. japonicum*) and various soil analyses for Sassafras sandy loam and Matapeake silt loam.

Serogroup	Distribution, %	Correlations obtained° Positive	Negative
		Sassafras Sandy Loam++	
46	14.6		
76	14.0	Soil K*	
94	10.0		
110	7.5	OM**; OrgN I*, V*, (NH_4^+)*; (NO_3^-)*	
122	18.6		
123	9.3	pH_A**, pH_B*, soil Mg*	OrgN IV*
125	4.7		OrgN II*
Composite‡‡	21.3	OrgN V*	
		Matapeake Silt Loam88	
46	9.9	Serogroup 76*	OrgN IV_B*
76	6.5		Soil P*
94	8.6	OrgN I**, III*; (NH_4^+)*	
110	7.2		
122	12.8	OrgN III_B*	
123	11.6		OrgN IV*
125	6.2		
Composite‡‡	37.2	OM*	

* Significant at the 5% level.

** Significant at the 1% level.

++ Distribution is the average of 10 sites with 45 nodules per site.

88 Distribution is the average of 9 sites with 45 nodules per site.

° Organic N (OrgN): I - 1st distillable fraction after $CaCl_2$ extraction; II - 2nd fraction after acidification; III - amino N; IV - unidentified; V - total N less fractions I-V.

‡‡ Composite consisting of serogroups 4, 6, 31, 38, 112, 124, 135, and negative.

Control of Johnsongrass in Soybeans With Toluidine Herbicides

Gordon Burt
Department of Agronomy

Purpose and Objectives

Trifluralin is known to control johnsongrass when applied at higher than normally recommended rates. The present study was conducted to determine the effectiveness of other toluidine herbicides which have a potential in johnsongrass control in soybeans.

Procedures

A johnsongrass infestation was selected for the experimental area near Cordova, Maryland. This area was infested with johnsongrass for more than 10 years. During the last ten years the area was not used agriculturally but was periodically mowed and spread with poultry manure. The soil was rated high for magnesium, very high for phosphate and medium for potassium by the soil testing service of the University of Maryland. The dominant soil series was Sassafras & Galestown sandy loam with a pH of 5.6 and 2.5% organic matter.

Preemergence herbicides (Table 1) were applied at 30 gallons per acre and immediately incorporated 3 to 4 inches deep. On June 5, 1972, the Kent variety of soybeans was planted. One cultivation was performed on July 10, 1972.

Plots were replicated four times in a randomized block design. Visual ratings of johnsongrass control and soybean injury were made several times throughout the season. Johnsongrass was harvested by hand on September 8, 1972 from the center row and the weight recorded. Soybeans were harvested from 15 feet of the two center rows of each plot on December 8, 1972.

Results

Several of the toluidine herbicides appeared to control johnsongrass as well as trifluralin (Table 1). BAS 3921H and nitralin had higher weed control ratings on 7/28/72 than trifluralin. All other herbicides, however, controlled johnsongrass less than did trifluralin. MBR 8251 and SD 27695 gave no significant johnsongrass control throughout the season.

No injury symptoms of soybeans were noticed at the beginning of the growth period for any treatment. At mid season, however, MBR 8251 plots were stunted and the soybean yield was significantly reduced at the end of the season (Table 1).

Summary

Nine different toluidine herbicides were evaluated in the field for johnsongrass control in soybeans. Trifluralin, nitralin and BAS 3921 H were the best treatments. MBR 8251 and SD 27695 gave no johnsongrass control.

Table 1. Control of johnsongrass in soybeans with toluidine herbicides.[a]

Herbicide	Rate of Application (lb/A)	Johnsongrass Control[b]	Johnsongrass[c] (lb/75 ft^2)	Total Weeds[c] (lb/75 ft^2)	Soybean Yield[d] (Bu lb/A)
Control	------	0 d	5.0 d	5.5 ab	21 c
trifluralin	1	50 ab	1.6 ab	2.8 ab	29 ab
control	------	0 d	5.0 a	5.5 ab	21 c
nitralin	1½	84 a	0.2 b	2.2 b	33 a
USB 3584	2/3	50 ab	3.2 ab	4.7 ab	28 ab
AN 56477	2	64 ab	0.9 ab	1.7 b	28 ab
CGA 10832	2	68 a	1.1 ab	2.6 ab	31 ab
A 820	2½	33 bc	2.7 ab	4.6 ab	26 abc
BAS 3921 H	1½	80 a	1.3 ab	3.7 ab	30 ab
MBR 8251	4	0 d	5.1 a	5.1 ab	11 d
SD 27695	2	0 d	4.7 ab	7.8 a	18 cd
SD 27695	4	10 cd	4.0 ab	4.9 ab	22 bc

[a]Values not followed by the same letter in the same column are significantly different at the 5% level according to the Student-Newman-Keuls' test.

[b]Visually rated on July 28, 1972. 0 = No control; 100 = 100% weed control.

[c]Harvested between the center 2 rows on October 20, 1972.

[d]Harvested 2 - 15 feet rows. Presented as bushels per acre of beans with 12% moisture.

Control of Johnsongrass in Soybeans with Trifluralin and Glyphosate

Gordon Burt
Department of Agronomy

Purpose and Objectives

Trifluralin is known to control johnsongrass when applied at higher than normally recommended rates. The present study was conducted to determine the effectiveness of various rates of trifluralin and other herbicides which have a potential in johnsongrass control in soybeans.

Procedures

A johnsongrass infestation was selected for the experimental area near Cordova, Maryland. This area was infested with johnsongrass for more than 10 years. During the last ten years the area was not used agriculturally but was periodically mowed and spread with poultry manure. The soil was rated high for magnesium, very high for phosphate and medium for potassium by the soil testing service of the University of Maryland. The dominant soil series was Sassafras & Galestown sandy loam with a pH of 5.6 and 2.5% organic matter.

Preemergence herbicides (Table 1) were applied at 30 gallons per acre and immediately incorporated 3 to 4 inches deep. On June 5, 1972, Soybeans var. Kentwere planted. One cultivation was performed on July 10, 1972. Glyphosate was post directed on July 10, 1972. The herbicide was applied as a 12 inch band in 53 gallons per acre. The johnsongrass was at this time 6 inches tall, the soybeans were 8 inches tall. The lower 2 inches of the soybeans were sprayed.

Plots were replicated four times in a randomized block design. Visual ratings of johnsongrass control and soybean injury were made several times

throughout the season. Johnsongrass was harvested by hand on September 8, 1972 from the center row and the weight recorded. Soybeans were harvested from 15 feet of the two center rows of each plot on December 8, 1972.

Results

Johnsongrass control by trifluralin at three different rates was considered satisfactory (Table 1). Total weeds harvested (Table 1) do not show any effect of trifluralin, because other weeds (especially common ragweed and jimsonweed) were very prevalent in these plots.

Glyphosate gave rather poor johnsongrass control (Table 1) and injured soybeans which did result in yield losses at the end of the season (Table 1). The poor johnsongrass control was primarily attributed to poor spray coverage, since there was little height differential at post directed treatment time the upper portions of the johnsongrass was not sprayed with glyphosate.

Summary

A field experiment was conducted to determine the effectiveness of various rates of trifluralin and glyphosate as post directed treatment for johnsongrass control in soybeans. Trifluralin gave satisfactory johnsongrass control with no soybean injury. Glyphosate post directed gave poor control of johnsongrass and caused soybean injury.

Table 1. Control of johnsongrass in soybeans with trifluralin and glyphosate[a].

herbicide	Rate of Application Lb/A	Normal rate equivalent of trifluralin	Johnsongrass Control	Johnsongrass[c] lb/75 ft^2	Total weeds[c] lb/75 ft^2	Soybean yields[d] (Bu/A)
Control	----	--------	0 c	4.1	5.0 a	21 c
Trifluralin	½	½	33 b	1.9	4.5 a	29 abc
Control	----	--------	0 c	1.3	5.1 a	21 c
Control	----	--------	0 c	3.7	5.5 a	21 c
glyphosate+ trifluralin	½+½	½	66 a	0.8	6.1 a	25 abc
glyphosate+ trifluralin	1+½	½	75 a	1.2	5.4 a	23 bc
glyphosate+ trifluralin	½+1	1	66 a	1.0	6.7 a	32 ab
glyphosate+ trifluralin	1+1	1	76 a	1.7	7.8 a	24 abc
Trifluralin	1	1	71 a	0.7	2.5 a	32 ab
Trifluralin	1½	1½	69 a	0.9	4.5 a	33 a
Trifluralin+ extra tillage	1	1	68 a	0.8	4.9 a	25 abc
alachlor	4		16 b	5.1	5.7 a	26 abc

[a]Values not followed by the same letter in the same column are significantly different at the 5% level according to the Student-Newman-Keuls' test.

[b]Visually rated on July 28, 1972. 0 = no control; 100 = 100% weed control.

[c]Harvested between the center 2 rows on October 20, 1972. fresh weight.

[d]Harvested 2 of the 4 rows. Presented as bushels per acre of beans with 13% moisture.

The Influence of Tillage Practices on the Winter Survival Of Johnsongrass Rhizomes

Gordon W. Burt
Department of Agronomy

Purpose and Objectives

The persistence of johnsongrass can be primarily attributed to over-wintering of its rhizomes. These rhizomes are, however, quite susceptible to cold injury and, therefore, it is possible that tillage operations in the fall could alter winter survival of the rhizomes. In this way it is possible that fall tillage could be used as a practical aid in johnsongrass control. Tillage of the soil could aid in the eradication of viable rhizomes throughout the winter by:

(a) mechanical injury

(b) movement of rhizomes to the soil surface where extremes of temperature and dissication could cause injuries.

(c) decreasing the soil heat capacity which would increase the soil depth at which temperatures lethal to rhizomes would occur.

The present study was conducted to determine:

(a) The influence of tillage and cover on the soil temperature in the winter.

(b) The critical temperature for rhizome death.

(c) The value of fall plowing for johnsongrass control.

Procedure

Five treatments (Table 1) were located in a johnsongrass infested field in a randomized block design with 2 replications on Oct. 14, 1971. The johnsongrass was seeded on July 5, 1971 at the Plant Research Farm.

Temperatures in each plot were recorded periodically throughout the winter at a depth of 10 and 20 cm with a battery-operated temperature recording system with 10 probes. The temperature of each probe was automatically recorded at 20 minute intervals. On March 21, 1972, rhizomes were removed and their weight recorded from an area 60 X 60 cm to a depth of 20 cm.

Results

Representative soil temperatures are presented (Table 2) for a 2 day cold period in February 1972. During these 2 days the minimum air temperature was 22° F. Data are presented for two periods of day which represent a time when air temperature is approximately at a daily maximum (Noon) and a daily minimum (2 a.m.).

Soil temperature at 10 cm depth was found to fluctuate widely, depending on the time of day and the tillage treatment (Table 2). At 2 a.m. on both Feb. 8 and 9 the soil temperature at 10 cm depth increased progressively from treatment 1 through treatment 5. For both days fall plowed land was 7°F cooler at 10 cm depth than land where no tillage occurred. Soil temperatures at noon, however, on those same two days showed little differences among treatments at both the 10 and 20 cm depth. At 10 cm depth noon temperatures were always greater than 2 a.m. temperatures. At 20 cm depth, however, there was a trend for noon temperatures to be somewhat less than 2 a.m. temperatures.

Total weight of viable rhizomes harvested to a 20 cm depth indicated that the fall plowing reduced the quantity of viable rhizomes present in the spring (Table 1). A poor stand of johnsongrass, however, resulted in a small amount and a nonuniform distribution of rhizomes in the experimental area. This resulted in no statistical differences among any treatments.

Summary

The amount of tillage and crops planted in the fall have been shown to effect soil temperatures throughout the winter season. The effect on soil temperatures, in turn, affected the quantity of viable johnsongrass rhizomes overwintering in the soil. Fall tillage practices appear to have potential in aiding the control of johnsongrass rhizomes in Maryland.

Table 1. Weight of Rhizomes Harvested in the spring from an area 60 X 60 cm to a depth of 20 cm.

Treatment Number	Tillage Operation	Total Weight (g) of Rhizomes Harvested
1	Fall Plowing	13
2	Fall Plowing and Disking	22
3	Fall Plowing and Disking, sown to Blueboy wheat	26
4	Fall Plowing and Disking, sown to Barsoy Barley	22
5	No tillage	24

Table 2. Soil temperatures (F) at 10 and 20 cm under different soil management practices.

Treatment Number	2 a.m. February 8		Noon February 8	
	10 cm. depth	20 cm. depth	10 cm. depth	20 cm. depth
1	25	34	33	34
2	26	36	33	35
3	28	35	32	35
4	33	35	33	34.5
5	32	35	33	34.5

Treatment Number	2 a.m. February 9		Noon February 9	
	10 cm. depth	20 cm. depth	10 cm. depth	20 cm. depth
1	25	34	34	33.5
2	24	35	33	34.5
3	28	34.5	33	34
4	32	34.5	33	34
5	32	34.5	33	34

A Comparison of Sunflower Varieties under Different Managements for Silage

N. A. Clark
Department of Agronomy

Purpose and Objectives

Corn silage is the leading producer of energy for dairy cattle on a single crop basis, but it is possible that certain multiple cropping sequences might outproduce corn in Maryland. In such a multiple crop sequence, a logical choice for the winter crop would be a cereal harvested as silage or a short season barley harvested as grain. The summer crop should be fast-maturing, highly productive, and drought tolerant. Drought tolerance is especially important because the winter crop leaves the soil low in moisture for the succeeding crop and, if summer rainfall is sparse, most crops will suffer. Sunflowers are drought tolerant and produce substantial tonnage in a short period of time.

The objectives of this study are to determine the potential yield and feeding value of sunflower silage under Maryland conditions. In order to do this, it is necessary to establish seeding rates and fertility levels for the sunflower types available for this area.

Procedures

The experimental planting was made on June 16. The study was set up in a factorial arrangement consisting of two fertilizer levels, three plant populations, and four sunflower varieties in a split-split plot design. Fertilizer levels were the whole plots, plant populations the first split, and varieties the final split. There were three replications. Harvests were made on August 23 when the plants were just beyond the flowering stage and the total plant dry matter was approximately 13 percent.

Results

Yields are shown in Table 1. Neither varieties nor fertilizer levels resulted in statistically significant yield differences. Populations, however, produced yields which were significantly different at the five percent level. These results indicate that the optimum population level may not have been attained even though the plants at the high population were spaced only three inches apart in 30-inch rows. Chemical determinations of the digestible components in the forage have not yet been completed.

Summary

An experiment was established to evaluate, as silage, four sunflower varieties under two fertilizer levels and three plant populations. Plots were planted on June 16 and harvested on August 23, 1972. Neither varieties nor fertilizer levels resulted in statistically significant yield differences, but yields were higher as plant populations increased. It is possible that the optimum population for maximum yield has not yet been attained.

Table 1. Sunflower silage yield - 1972.

Fertilizer Rates	Population	Variety*			
		A	M	P	K
Pounds/acre	plants/acre	DM tons/acre			
50-100-100 (L)	17,424 (L)	2.2	2.7	1.8	2.4
	34,848 (M)	3.1	2.8	3.2	2.8
	69,696 (H)	3.5	4.4	3.7	2.8
100-200-200 (H)	17,424 (L)	2.6	2.4	2.6	2.1
	34,848 (M)	3.2	2.9	3.2	3.3
	69,696 (H)	4.4	3.7	3.8	3.1

* (A) Arrowhead (Birdseed type) (P) Peredovic (Oil type)
(M) Mingren (Birdseed type) (K) Krasnodarets (Oil type)

50
2.24
50

1200

Harvest Management of Crownvetch - Tall Fescue Mixtures

A. M. Decker
Department of Agronomy

Purpose and Objectives

Crownvetch has long been recognized as an excellent species for ground cover and bank stabilization. Because of its wide adaptibility to soil and climatic conditions, considerable interest has been generated in recent years in utilizing this species as a forage in the livestock industry.

Early work at Maryland and other states suggests that crownvetch could best be utilized as a forage when grown with a grass. With this in mind, stands of crownvetch and Ky-31 tall fescue were established. The objectives of the study were to measure total forage production and seasonal distribution of that forage as influenced by harvest frequency and stubble height. A third objective was to study the effects of harvest management on persistence of crownvetch.

Procedures

Penngift and Chemung crownvetch were seeded in randomly selected plots in each of four replications of the study. Ky-31 tall fescue was uniformly seeded in all plots and all borders. The experimental area was uniformly harvested during 1969 while grass-legume mixtures were stabilizing. Differential harvest treatments were started in 1970. The design of experiment was a split plot with four replications. Crownvetch varieties were whole plots, harvest frequency (3, 4, 5 cuts) were subplots, and stubble heights (3.8, 6.4, 8.9 cm) were sub-sub plots.

Total forage yields, seasonal distribution of that forage and persistence of crownvetch varieties were reported in the 1970 and 1971 reports.

In 1972, two uniform harvests were taken in order to measure residual treatment effects.

Results

In 1972, the third year of the study, Chemung crownvetch had largely disappeared from all harvest treatments; significant amounts of crownvetch were present only on those plots that had been cut at the late bloom stage for the past two years. Stands of Penngift, on the other hand, were adequate on all treatments except those plots cut at the early bloom stage. Although differences were small, the low stubble harvests were relatively better when first harvest was made earlier in the spring.

Dry matter yields generally followed the same trends as the legume component. These differences would have been even larger had volunteer white clover been eliminated from all plots. White clover was quite high in some plots where the crownvetch component was low, but there was a large degree of variability from plot to plot.

Summary

1. Penngift was more persistent than Chemung.
2. Penngift - tall fescue mixtures were more productive than mixtures with Chemung.
3. Stubble height had little residual effect on yield or persistence.
4. Delaying the first spring harvest until late bloom resulted in greatest persistence.
5. Making the first spring harvest at early bloom was most detrimental.

Table 1. Total yields from two uniform harvests to measure residual treatment effects of harvest management treatments on crownvetch - tall fescue mixtures.

Variety(V)	Growth Stage(S)	Stubble Height(H)	Code	Dry Matter Yields (2 cuts) Crownvetch	Dry Matter Yields (2 cuts) Total	Percentage Crownvetch
		cm		T/A	T/A	%
Chemung	Veg.	3.8	VSH	.22 efg[1/]	2.74 c-g	8.2
		6.4	VSH	.11 g	2.11 g	5.3
		8.9	VSH	.16 fg	2.35 g	6.7
		Av.	VS	.16 q	1.97 o	6.5
	E. Bloom	3.8	VSH	.27 d-g	2.51 efg	10.7
		6.4	VSH	.16 fg	2.49 efg	6.3
		8.9	VSH	.25 efg	2.60 d-g	9.5
		Av.	VS	.23 pq	2.53 o	8.8
	L. Bloom	3.8	VSH	.65 bc	2.33 fg	27.9
		6.4	VSH	.60 bcd	2.56 efg	23.1
		8.9	VSH	.63 bc	2.71 c-g	23.1
		Av.	VS	.63 no	2.53 o	24.7
	Av.	3.8	VH	.38 s	2.51 s	15.2
		6.4	VH	.29 s	2.38 s	12.3
		8.9	VH	.34 s	2.56 s	13.2
		Av.	V	.34 B	2.48 A	13.5
Penngift	Veg.	3.8	VSH	.94 b	3.32 abc	28.4
		6.4	VSH	.94 b	3.23 a-d	29.2
		8.9	VSH	.72 bc	3.12 a-e	23.0
		Av.	VS	.83 n	3.23 mn	27.1
	E. Bloom	3.8	VSH	.45 c-g	2.64 d-g	17.0
		6.4	VSH	.49 c-f	2.42 fg	20.4
		8.9	VSH	.54 cde	2.96 b-f	18.2
		Av.	VS	.49 op	2.67 no	18.3
	L. Bloom	3.8	VSH	1.30 a	3.36 abc	38.7
		6.4	VSH	1.41 a	3.68 a	38.4
		8.9	VSH	1.30 a	3.50 ab	39.2
		Av.	VS	1.34 m	3.51 m	38.5
	Av.	3.8	VH	.90 r	3.12 r	28.8
		6.4	VH	.94 r	3.09 r	30.4
		8.9	VH	.85 r	3.18 r	26.8
		Av.	V	.90 A	3.13 A	2.86
Averages:	Veg.		S	.52 D	2.80 C	18.4
	E. Bloom		S	.36 D	2.60 C	13.8
	L. Bloom		S	.99 C	3.03 C	32.6
		3.8	H	.63 F	2.82 F	22.2
		6.4	H	.63 F	2.73 F	23.0
		8.9	H	.58 F	2.87 F	30.5
CV%				3.2	13.6	

1/ Values within each column with the same letter are from the same statistical population at 5% level. (Significance applied to code letters as follows: V = A,B; S = CDE; H = FGH, VS = m-q; VH = r,s; VSH = a-g)

Red Clover Forage Yield and Stand Persistence Study

A. M. Decker and C. S. Garrison
Department of Agronomy and U.S.D.A.

Purpose and Objectives

Red clover acreages have been declining for the past twenty years, but, by far, it is still the most widely grown forage legume in Maryland. Twenty years ago most red clover seed planted in Maryland was also produced in Maryland or neighboring states. However, with the introduction of new improved varieties like Kenland and Chesapeake, seed production has moved to the West where seed yields are much higher and more reliable.

Red clover varieties that are grown outside of their major area of adaptation can change drastically. The objectives of this study were to evaluate forage yields and stand persistence of Kenland red clover entries produced in various U.S. locations for a different number of seasons, and to compare Kenland with Chesapeake and Kenstar varieties.

Procedure

Thirty-one Kenland, ten Chesapeake, and one Kenstar entry were seeded at the Agronomy - Dairy Forage Research on April 21 (reps 2 through 6) and April 28 (rep 1). Because of excessive rain throughout much of the season, weeds were a serious problem. The experimental area was uniformly harvested twice and all material was removed from the plots. No forage yields were taken in 1972, but stand ratings were made on three different dates.

Results

Good stands were obtained for all entries except for five Chesapeake entries and one Kenland breeders lot. The poor stands of Chesapeake appeared to be due to a lack of seedling vigor more than a lack of germination, but no data were collected to substantiate this fact. Stand ratings

on May 31, 1972; August 11, 1972; and March 29, 1973, are presented in Table 1. The inferiority of some poor Chesapeake entries persisted while some entries of Chesapeake and Kenland improved with time. There was a tendency for Kenland lots grown in Washington and Oregon to be better than those grown in California. There was generally little difference between different seed crops except in the case of Chesapeake. These differences were probably due to seed storage conditions rather than environmental pressures in the field.

Summary

1. Large differences in initial stands were obtained.
2. Some entries with weak stands improved with time, while others d d not. In no cases, however, did stands deteriorate from May 13, 1972, to March, 1973.

Table 1. Stand rating of red clover varieties and strains. Agronomy - Dairy Forage Research Farm, Clarksville, Maryland.

Variety	Seed Class	Entry	Stand Rating (1 = poorest, 5 = best) 5-31-72	8-11-72	3-29-73	Av.
Kenland	Foundation	Washington	3.3	4.5	4.0	3.9
Kenland	Foundation	Washington	3.5	4.0	4.0	3.8
Kenland	Breeder	19-L38-96	2.0	3.7	4.2	3.3
Kenland	Foundation	Washington	3.0	4.0	4.8	3.9
Kenland	Foundation	Washington	3.0	4.2	4.7	4.0
Kenland	Foundation	Washington	2.5	4.7	4.3	3.8
Kenland	Foundation	Washington	3.3	4.3	4.3	4.0
Kenland	Breeder	59-L38-96	3.2	4.2	4.7	4.0
Kenland	Foundation	Washington	3.7	4.2	4.3	4.1
Kenland	Foundation	Washington	2.8	3.8	4.7	3.8
Kenland	Foundation	Washington	2.5	4.3	4.5	3.8
Kenland	Breeder	89-L38-96	2.3	4.0	5.0	3.8
Kenland	Foundation	Washington	2.7	4.5	4.5	3.9
Kenland	Breeder	39-L38-96	2.7	3.3	4.5	3.5
Kenland	Breeder	79-L38-96	2.5	3.7	4.7	3.6
Kenland	Certified	Oregon	3.3	3.8	4.5	3.9
Kenland	Certified	Oregon	3.5	4.0	4.7	4.1
Kenland	Certified	Oregon	3.5	3.5	4.3	3.8
Kenland	Certified	Oregon	3.0	3.7	4.5	3.7
Kenland	Certified	Oregon	3.3	4.0	4.3	3.9
Kenland	Certified	Oregon	3.3	3.8	4.3	3.8
Kenland	Certified	Calif	3.7	3.7	4.2	3.9
Kenland	Certified	Calif	3.3	4.2	4.2	3.9
Kenland	Certified	Calif	3.5	3.7	4.5	3.9
Kenland	Certified	Idaho	3.5	3.5	4.5	3.8
Kenland	Certified	Oregon	2.7	4.7	4.3	3.9
Kenland	Certified	Washington	3.2	3.7	4.5	3.8
Kenland	Certified	Washington	3.2	4.3	4.7	4.1
Kenland	Certified	Washington	3.5	4.7	4.3	4.2
Kenland	Breeder	99-L38-96	2.7	4.2	4.7	3.9
Kenland	Foundation	Calif	3.0	4.3	4.7	4.0
Kenstar	Breeder	Kentucky	2.7	4.0	4.7	3.8
Chesapeake	Breeders 1963,5,6,7	Calif 1971	2.8	3.7	3.8	3.4
Chesapeake	Breeders 1963,5,6,7	Calif 1971	3.2	3.8	3.7	3.6
Chesapeake	Breeders 1963,5,6,7	Idaho 1971	3.8	3.7	3.8	3.8
Chesapeake	Breeders 1971	Md 1971	3.2	4.2	3.5	3.6
Chesapeake	Breeders 1955,6	Md 1955,6	2.2	3.2	3.5	3.0
Chesapeake	Breeders 1963,5,6,7	Md 1963,5,6,7	1.2	1.7	3.0	2.0
Chesapeake	Breeders 1968	Md 1968	2.2	3.5	3.2	3.0
Chesapeake	Breeders 1966	Md 1966	1.0	2.2	2.0	1.7
Chesapeake	Breeders 1961,3,4,5	Calif 1968	1.0	3.0	3.0	2.3
Chesapeake	Breeders 1969	Calif 1969	3.7	3.5	4.0	3.7

Responses of Early, Medium, and Late Corn Varieties to Controlled Field Soil Temperature

A. M. Decker and J. M. Walker
Department of Agronomy and U.S.D.A.

Purpose and Objectives

Temperature exerts a major influence on plant growth and crop production, but the degree to which soil temperature *per se* controls these responses is not fully understood. The high correlation between air and soil temperatures contributes to this problem.

Most studies concerned with effects of soil temperature have been conducted either in the greenhouse or growth chamber where environmental factors are controlled. While this has provided valuable information, such conditions are "artificial", and results are often difficult to translate to actual field situations.

In 1971, corn was grown in the field at four soil temperature regimes and three fertility levels. In this study, plant developmental rates were effected by soil temperature. In 1972, therefore, three hybrids with different maturity dates were grown in the temperature plots at the high fertility level uses in 1971. The objectives were to follow the growth pattern and yield of these hybrids as influenced by soil temperature.

Procedure

Funk varieties 17-A (early), 4550 (medium), and 5757 (late) were grown in the field at soil temperatures of 16 C, 24 C, 32 C, and ambient. All plots were uniformly fertilized with 224, 99, and 372 kg/ha of N, P, and K, respectively. Plants at a uniform 2-leaf stage were transplanted into the field at a population of 77,511 plants / ha (31,363/A). All plots were covered with a uniform 5-cm (2-in) straw mulch to maintain desired soil temperatures. Temperature plots were individually irrigated to maintain "uniform"

soil moisture. The experimental design was a split plot with three replications. Soil temperatures were whole plots and varieties were sub-plots.

The rate of plant development in terms of plant height, leaf number, and leaf width (last fully-developed leaf on each plant) was determined weekly. Tasseling and silking dates, along with general plant condition, were recorded throughout the growing season. When plants of a particular treatment reached the medium to late dent stage (grain moisture approx. 30%), the entire plant was harvested and dry matter yields of tillers, main stalk, ear leaf, other leaves, husk, cob, and grain were determined.

Results

Space does not allow for presentation of all data collected, so only a small percentage will be shown to illustrate major responses to soil temperature.

Leaf development and plant height relationships for 17-A were similar to those obtained in 1971 with that variety. These data will not be shown, but there was an increase in the rate of leaf development and plant height with increased soil temperature. This increase was greater with the later maturing varieties. Differences between varieties were greatest at 32 C and least at 15 C. The height of the ear on the stalk was highest at 34 C and ambient and shortest at 32 C, with 15 C being intermediate. Ear height generally increased with later maturing varieties. The greatest difference between varieties again occurred at soil temperature of 32 C.

While the effects of soil temperature on plant growth rates are important, the most critical measure is grain yields. These values are given in Table 1 along with tiller production and total dry matter yields. As was the case in 1971, highest grain yields generally occurred at ambient soil temperature. However, in the case of the later maturing vari-

eties, the adverse effects of high soil temperature were not as severe. The decrease in yields was greater at below ambient than at above ambient soil temperature. At high soil temperature the later maturing varieties performed relatively better, while at the cold soil temperatures the early variety performed best. Total dry matter yields were about 50% less at 15 C than at ambient, while at 32 C the reductions ranged from 5 to 12%. Tiller or sucker production was greatly increased with increased soil temperature, and the tendency for sucker development was greater with earlier-maturing varieties.

Summary

1. Soil temperature affects the rate of leaf development and plant height.
2. Varieties differ in their response to soil temperature.
3. Grain yields were highest at ambient soil temperature.
4. Cold soil temperatures reduced plant growth and final yields more than high soil temperatures.

Table 1. Dry matter yields of three corn hybrids grown at four soil temperature regimes.

Treatments		Grams per Plant		
Soil Temp.	Hybrid	Tillers	Grain	Total
15 C	17-A	.07	87.27	161.60
	4550	.00	90.17	187.87
	5757	.00	95.30	196.87
	Av.	.02	90.91	182.11
Check	17-A	5.67	161.70	327.07
	4550	1.97	183.27	378.47
	5757	.17	187.17	413.90
	Av.	2.60	177.38	373.14
24 C	17-A	7.93	141.43	315.40
	4550	3.67	170.50	356.23
	5757	3.07	181.03	402.80
	Av.	4.89	164.32	358.14
32 C	17-A	12.37	135.43	287.90
	4550	10.50	175.17	369.97
	5757	4.17	183.57	394.27
	Av.	9.01	164.72	350.71
Av.	17-A	6.51	131.46	272.99
	4550	4.03	154.77	323.13
	5757	1.85	161.77	351.96

Reactive Sand and Silt Fractions in Middletown Valley Soils

C. B. Coffman and D. S. Fanning
Department of Agronomy

Purpose and Objectives

Earlier studies (4, 5) have shown a poor correlation between cation exchange capacity values and clay contents of soils from the Appalachian Mountain region of Maryland and the strong probability that soils from the Middletown Valley region contain considerable quantities of reactive (CEC contributing) minerals in their sand and silt fractions. The main soil series in this area are Myersville and Fauquier. These soils have developed from chloritic metabasalt with the chlorite in the rock apparently giving rise to vermiculite in the soil (2). The purpose of this study was to obtain more information about the kinds and amounts of reactive minerals in the various particle-size fractions of soils of this area. The specific objectives were:

1. To particle size fractionate the Ap, B22t, C1 horizons and underlying deep saprolite of a Myersville soil.

2. To determine the CaEC, KEC, % vermiculite, and vermiculite interlayer fraction (VIF) of the CaEC of the particle-size fractions and the contribution of each size fraction to the overall CEC characteristics.

Procedures

The samples were collected as part of a larger study of these soils (2). The samples were particle-size fractionated into 5 sand, 3 silt, and 2 clay fractions by means of centrifugation and sieving (2). Calcium exchange capacity (CaEC) was determined by saturation with calcium acetate, $Ca(OAC)_2$,

of pH 7 and replacement with $Mg(OAC)_2$. Potassium exchange capacity (KEC) was determined by saturation with KOAC of pH 7 and replacement with NH_4OAC after overnight oven-drying at 110°C.

Using the CaEC and KEC values the percent "vermiculite" ("Vr") and the fraction of the CaEC attributable to "vermiculite" interlayers (called "vermiculite" interlayer fraction or VIF) were calculated for each fraction by means of the following equations:

$$\% \text{ "Vr"} = \frac{\text{CaEC (me/100g)} - \text{KEC (me/100g)}}{154 \text{ me/100g}} \times 100$$

$$\text{VIF} = \frac{\text{CaEC-KEC}}{\text{CaEC}}$$

Details of the procedures used and background theory is given by Coffman (2) and Coffman and Fanning (3).

Although the determinations were made for all of the individual sand, silt, and clay subfractions, the data were calculated to the basis of single sand, silt, and clay fractions for presentation here.

Results

The data obtained are presented in Table 1 and Fig. 1. In Table 1 the CaEC, KEC, % "Vr", and VIF values of the sand, silt, and clay fractions of each of the materials is presented. From the data is is seen that the sand and silt fractions of these soils truly are reactive in the sense that they have high CaEC and "vermiculite" content values. This was particularly true for the saprolite sample. The highest CaEC value observed for any of the fractions studied was for the sand of the saprolite. Although CaEC and percent "vermiculite" values of the silt and sand fractions of the Ap horizon (plow layer) were less than for these fractions in deeper horizons, they still

were very significant in overall contribution to the whole soil properties (discussed further below in conjunction with Fig. 1).

On the other hand, KEC values were always quite small for the silt and sand compared to the clay. This indicates that, although the coarser fractions exhibit considerable CEC for some cations, many of the exchange sites may be blocked by K fixation. This is typical of the mineral vermiculite. The % "vermiculite" and VIF values indicate that vermiculite apparently is the main mineral that gives rise to CaEC in the silt and sand fractions of these soils. The quotation marks are used to indicate that this "vermiculite" is determined by the cation exchange capacity methods and that it may not correspond exactly with strictly defined mineralogical vermiculite. Further rationale for this approach are given by Coffman and Fanning (3).

In Fig. 1 the contribution of each of the three particle-size fractions to the weight, % "Vr", CaEC, and KEC of each horizon is shown. Taken into consideration here in calculating the contribution of each fraction to the CaEC, KEC and % "Vr" is both the value of the property in the particular fraction and the amount of the fraction in the horizon. This tends to magnify the contribution of the silt and sand fractions because not only are they quite reactive (Table 1), but also they (combined) compose much more of each horizon than the clay (see weight percentages in Fig. 1). Thus, the silt and sand (together) contribute more than the clay to the CaEC and % "Vr" of all the horizons. However, the clay contributes more than the other fractions to KEC for all the horizons except the saprolite. Of the silt and sand, the silt was more important than the sand in the Ap, B22t and C1 horizons, but the sand was more important in the saprolite.

Summary

This study (in conjunction with a larger study - Coffman, 1972) shows that the silt and sand fractions may contribute significantly to the cation exchange characteristics and vermiculite content of soils in the Middletown Valley region of Maryland. It helps to explain why a poor correlation exists between clay content and CEC in the Appalachian Mountain region of Maryland when soils such as the Myersville are included in the correlation. Although the soils of this region are probably quite exceptional in the high amount of CEC bearing minerals that they have in their sand and silt fractions, other soils containing reactive layer silicate minerals in their silt and sand fractions have been reported (1). Such soils usually have developed on rocks containing layer silicate minerals. Techniques that look at the CEC properties and "vermiculite" content on a whole soil basis have been developed (2, 3) and are especially meaningful in characterizing soils such as these from the Middletown Valley.

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Table 1. The cation exchange capacity properties of the sand, silt and clay particle-size fractions of a Myersville soil sampled near Middletown, Md.

	Sand 0.05-2 mm	Silt 0.002-0.05 mm	Clay 0.002 mm	Whole Soil
	---------- Ap (0-15 cm)----------			
CaEC (me/100g)	9.6	15.0	40.6	20.3
KEC (me/100g)	2.2	4.3	18.2	7.3
% "Vr"	4.8	6.9	14.5	8.4
VIF	0.77	0.71	0.55	0.64
	----------B22t (41-56 cm)----------			
CaEC (me/100g)	7.6	23.1	36.2	23.9
KEC (me/100g)	0.4	2.3	21.2	6.9
% "Vr"	4.7	13.5	9.7	11.0
VIF	0.95	0.90	0.41	0.71
	----------C1 (62-115 cm)----------			
CaEC (me/100g)	8.4	13.1	27.6	15.2
KEC (me/100g)	2.0	3.2	15.0	5.2
% "Vr"	4.2	6.4	8.2	6.5
VIF	0.76	0.76	0.46	0.66
	----------Saprolite (deep, about 3 meters)----------			
CaEC (me/100g)	61.3	42.5	32.0	51.6
KEC (me/100g)	2.7	2.9	18.6	4.1
% "Vr"	38.1	25.7	8.7	30.8
VIF	0.96	0.93	0.42	0.92

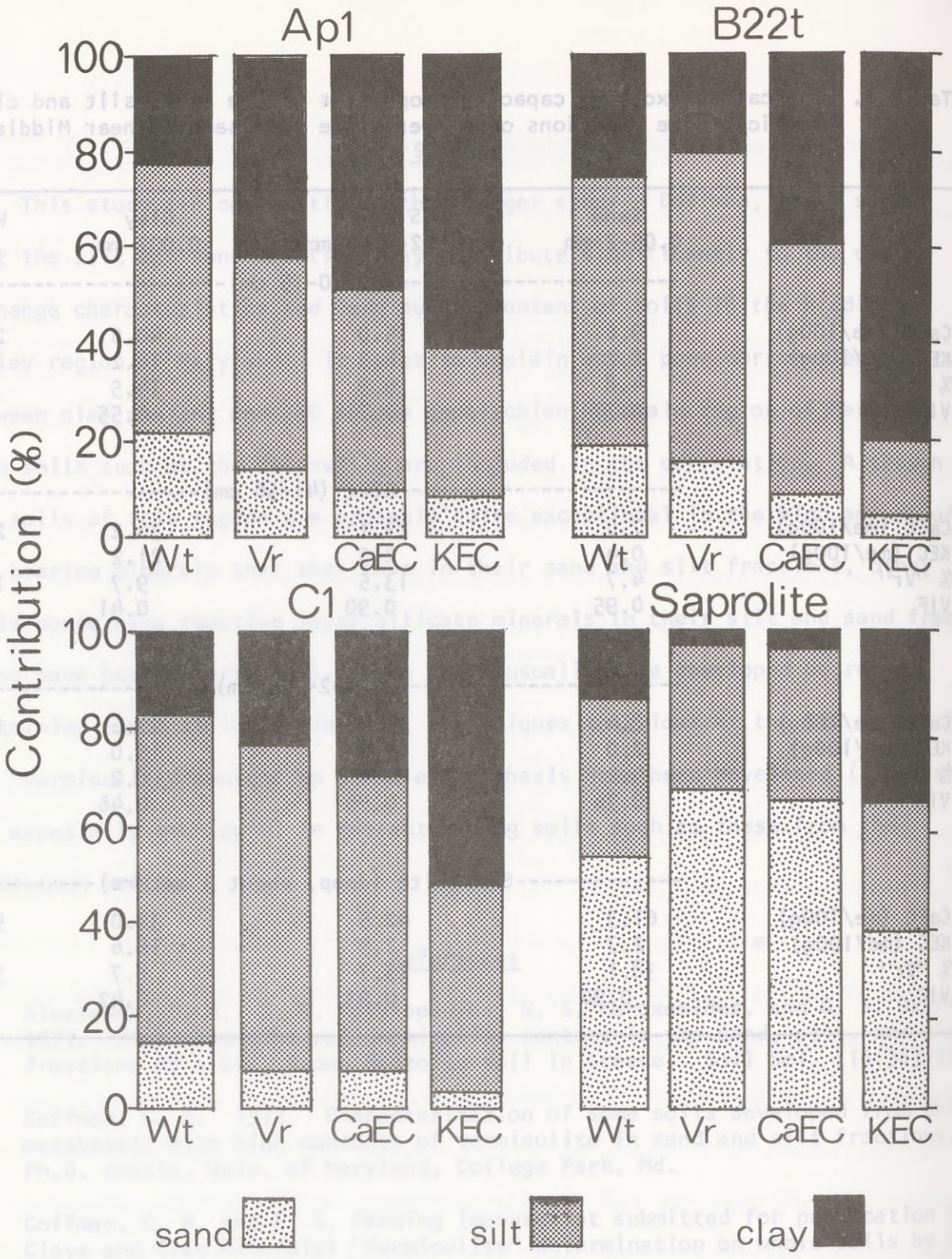

Fig. 1 Legend

Contribution (in percent of the total for each horizon) of the sand, silt, and clay to the weight, "vermiculite" content, CaEC and KEC values for 4 horizons from a Myersville soil.

Study of Tidal Marsh Soils in the Chesapeake Bay Area

R. G. Darmody, J. E. Foss, and D. S. Fanning
Department of Agronomy

Purpose and Objective

A reconnaissance soil survey of the tidal marshes of Maryland is presently being conducted. The objectives of this project are to ascertain some of the properties of Maryland's marsh soils and then to use these characteristics as a basis for mapping and classifying the soils. The information gathered in this study will enhance subsequent research in these areas. While the current U.S.D.A. classification system does include some provisions for tidal marsh soils, existing soil surveys in Maryland delineate them only as "tidal marsh" with no further description. The sampling to date indicates a wide variation in certain parameters of marsh soils. These include percent organic matter, nutrient content, texture of the mineral base, and pH change on drying.

The large geographic area and limited funds involved will preclude a detailed survey of tidal marshes in Maryland, but this project will provide detailed descriptions and analyses of representative tidal marsh soils. It is hoped that the results of this research will provide some understanding as to the nature of Maryland's 200,000 acres of tidal marshes and give a basis for future studies and mapping of tidal marsh soils.

Procedures

In first attempting to sample tidal marsh soils, it was found that no existing device tested was adequate in retrieving samples from some deep marshes. A 3-inch bucket auger was modified to permit deep sampling. To a standard bucket auger, a means to introduce air beneath the sample was added. This prevented the formation of a vacuum which would otherwise tend to "suck" out the sample. The modifications included a stainless steel tube

attached to the outside of the bucket with one end terminating within the hollow shaft and the other end free at the lower inside of the cutting edge. An air bulb was added at the top of the shaft for clearing the tube of soil. The conventional cutting edge was then sharpened to allow progress through the more fibrous peats found in some marshes. This auger was usually found to be successful in sampling even "mucky" soils. In clayey marshes the tube had a propensity to clog beyond the capacity of the air bulb's ability to build up pressure to clear it. It was found that Juncus Roemerianus leaves proved most effective in removing the compacted clay.

Samples were taken approximately every 10 inches to a depth of 60 inches where possible. They were placed in plastic bags and brought to the laboratory. The pH and color were determined for the moist samples as soon as possible. The samples were then spread out on plastic film and allowed to air dry. The laboratory data are presented on an air dry basis. Total soluble salts were determined by means of a solu-bridge and NaCl standards. A Beckman pH meter was used to measure the pH of the soil. Organic matter determinations were made using the Walkley-Black method. Extractable nutrients were determined by the University of Maryland soil testing laboratory. A method of determining sulfur in marsh soils by means of x-ray fluorescence is currently being developed.

All sampling was done by vegetative type to determine if a correlation exists between soil characteristics and vegetative type. Figure 1 shows the location of sampling sites.

Results

Table 1 summarizes the results of the chemical and physical data on 21 soil profiles from tidal marsh areas. The pH of the surface horizons was generally slightly acid (mean of 6.4), and upon drying the pH dropped about one unit. Total soluble salts of surface horizons were quite high except in fresh-water marshes. The organic matter content of surface and subsurface horizons average 55.8 and 18.0%, respectively. A wide variation of organic matter contents was noted in the subsoil horizon (0.2 to 64.7%). Extractable nutrients showed the following order of abundance: Mg > Ca > K > P > Na.

The thickness of organic horizons (histic epipedon) was quite variable, but generally the thinner organic horizons were associated with a coarser substratum. Vegetative types may also influence thickness of organic horizons. Additional study is needed to test these hypotheses.

Summary

As to correlating vegetative types with soil characteristics, a few tentative conclusions can be made. The soil characteristic which seems to be best correlated to vegetative type is the soluble salt content. With additional information on other sites, general categories of salt content in soil with vegetative type will be possible. Fresh marsh vegetation is characteristically Typa, while salt marsh vegetation is typified by Spartina.

Although all tidal marsh soils are grouped into one unit in Maryland, the work to date shows a great deal of variation in these soils. Vegetation can possibly be used as an indicator for some of the variations in soil properties.

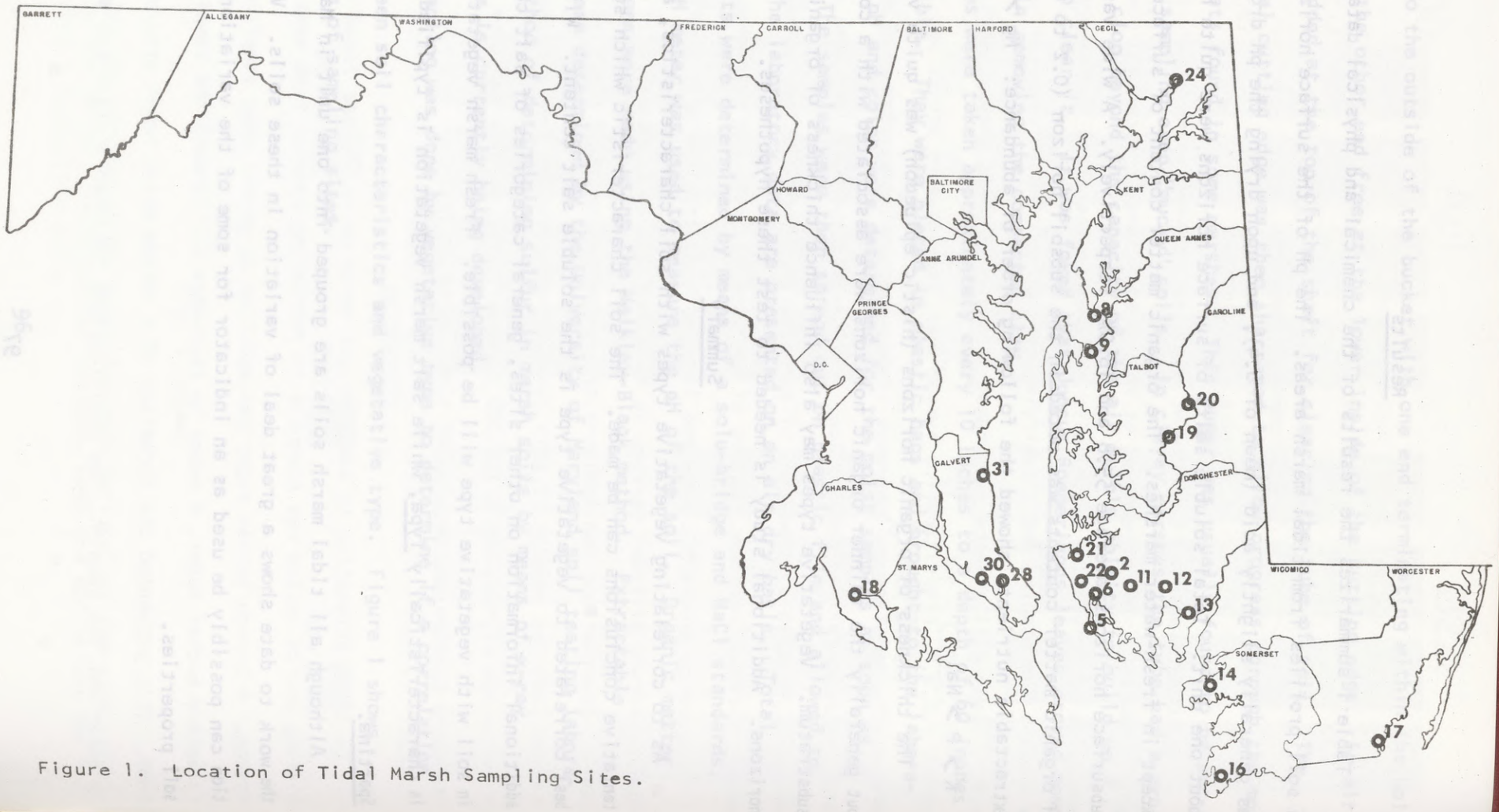

Figure 1. Location of Tidal Marsh Sampling Sites.

Table 1. Characteristics of Tidal Marsh Soils

Table 1. Characteristics of Tidal Marsh Soils

Site No.	pH Wet	pH Dry	Total Soluble Salts PPT	% Organic Matter	Extractable Nutrients Mg pp2m	P_2O_5 pp2m	K_2O pp2m	Ca pp2m	Na %	Depth of Organic Horizon (in.)	Texture of Sub-Organic Horizons	Predominant Vegetation	County
1 Surface	5.6	5.8	30.83	65.9	7600	175	1735	6300	0.53	12	sand	Scirpus olneyi	Dorchester
Subsurface	6.4	6.2	1.67	0.3	390	50	105	300	0.7				
2 Surface	6.6	6.4	8.67	78.7	6100	100	750	7600	0.31	24+	--	S. olneyi	Dorchester
Subsurface	6.6	6.3	22.00	--	10500	75	1260	8400	0.61				
3 Surface	6.6	5.7	51.13	67.3	5500	125	3675	4500	1.56	24	silt loam	S. olneyi	Dorchester
Subsurface	7.0	6.5	70.00	54.0	5950	100	3075	4100	2.51				
4 Surface	7.2	6.5	45.50	40.7	6150	100	2625	3600	1.57	24	silt loam	S. olneyi	Dorchester
Subsurface	7.1	4.2	23.38	16.6	3600	74	1800	1800	0.78				
5 Surface	6.8	5.8	46.88	61.4	5050	50	2250	3500	1.49	24	silt loam	Spartina patens	Dorchester
Subsurface	6.6	6.1	76.50	59.0	10250	50	4050	5900	2.60				
6 Surface	6.5	5.3	63.50	45.9	5450	50	2700	2600	1.94	22	silty clay loam	Juncus Roemerianus	Dorchester
Subsurface	7.1	5.8	10.80	6.2	2250	75	1180	1000	0.35				
7 Surface	6.5	5.4	42.00	58.5	7350	125	2925	5700	1.26	18	silt loam	J. Roemerianus	Queen Annes
Subsurface	6.7	6.5	4.17	0.5	520	50	450	300	0.14				
8 Surface	6.7	4.3	30.88	47.13	5750	100	2175	5400	0.90	30	silt loam	S. patens	Kent
Subsurface	7.1	5.5	4.68	2.15	620	75	465	300	0.14				
9 Surface	4.9	5.0	24.83	29.8	1160	25	780	600	0.24	24	silt loam	Phragmites communis	Queen Annes
Subsurface	6.5	6.5	5.42	1.2	780	175	480	400	0.19				
11 Surface	6.8	5.5	38.15	75.5	6600	50	6050	6000	1.01	60 +	--	S. olneyi	Dorchester
Subsurface	7.1	3.9	55.00	64.7	7250	25	2175	4200	1.51				
12 Surface	7.1	6.0	70.00	58.7	5900	25	2250	3900	1.60	12	sandy loam	J. Roemerianus	Dorchester
Subsurface	4.0	3.6	3.75	0.3	400	25	15	200	0.14				

Table 1. (continued)

Site No.	pH Wet	pH Dry	Total Soluble Salts PPT	% Organic Matter	Extractable Nutrients Mg pp2m	P_2O_5 pp2m	K_2O pp2m	Ca pp2m	Na %	Depth of Organic Horizon (in.)	Texture of Sub-Organic Horizons	Predominant Vegetation	County
14 Surface	6.0	4.9	65.17	57.07	5400	100	3250	3900	2.28	36	loam	J. Roemerianus	Somerset
Subsurface	6.2	5.3	6.34	2.82	740	75	675	400	0.21				
16 Surface	6.0	5.9	107.25	75.12	11250	125	5400	6600	2.0	6	clay loam over loamy sand	J. Roemerianus	Somerset
Subsurface	6.4	5.9	5.83	0.24	440	25	300	300	0.19				
17 Surface	6.0	6.2	155.00	48.81	11000	175	6500	6100	4.8	12	silty clay	Spartina alterniflora	Worcester
Subsurface	6.6	6.1	113.13	41.57	9750	225	4350	4700	3.60				
18 Surface	6.5	4.3	11.25	35.36	4000	125	885	2600	0.14	14	gravelly sand	mixed brackish	Charles
Subsurface	7.0	5.4	0.65	0.77	490	75	180	400	0.04				
19 Surface	6.1	5.2	4.63	21.38	3350	200	840	1800	0.17	24+	--	mixed brackish	Caroline
Subsurface	6.4	5.2	14.50	62.40	5600	100	1110	5800	0.42				
20 Surface	6.6	4.8	4.00	58.65	3650	75	180	4300	0.06	50	silt loam	mixed fresh	Talbot
Subsurface	5.9	4.9	1.75	18.54	2100	50	240	1500	0.08				
21 Surface	5.8	4.4	52.5	94.90	5160	175	4050	5100	1.33	10	clay loam over sand	S. patens & Disticulus	Dorchester
Subsurface	4.4	4.1	3.33	0.30	440	25	180	300	0.13				
22 Surface	6.5	5.6	67.0	89.28	7500	75	3870	7300	2.36	15	silt loam	S. olneyi	Dorchester
Subsurface	4.4	4.4	4.25	0.54	840	25	265	300	0.23				
24 Surface	6.4	4.7	1.0	21.98	790	175	345	1100	0.04	60+	--	Typha	Cecil
Subsurface	5.6	4.4	1.0	27.52	950	75	105	900	0.07				
25 Surface	6.9	5.6	--	39.23	3650	50	1470	5200	0.78	12	clay loam over sand	S. patens & Disticulus	Dorchester
Subsurface	5.3	4.7	--	0.19	400	25	165	300	0.14				

Breeding and Evaluation of Kentucky Bluegrass for Turf

J. R. Hall
Department of Agronomy

Purpose and Objectives

Selecting a Kentucky bluegrass (Poa pratensis L.) cultivar that will perform well in Maryland is a difficult task. There are currently more than 50 cultivars available to professional and amateur turfgrass managers. It is the purpose of this test to evaluate new experimental and commercial bluegrass cultivars to determine which are most likely to provide a quality turf in Maryland.

The objectives of this study were:

1) To compare bluegrass cultivar performance at a $1\frac{1}{2}$ inch mowing height.
2) To observe seasonal fluctuations in cultivar quality.

Procedure

Forty-two Kentucky bluegrass cultivars were seeded in the fall of 1968 in a randomized complete block experimental design with three replications and individual plot size of 4' by 6'. Two vegetative cultivars (Warren's A-10 and A-20) were sodded into vacant plots in the fall of 1969. The experiment is located at the Plant Research Farm (near Fairland) and includes all 44 cultivars fertilized at the rate of 3 lb N/1000 sq ft/yr and mowed as frequently as needed at a $1\frac{1}{2}$" mowing height. The plots are not irrigated unless drought threatens survival.

All experiments are rated monthly from April through November for color, density and quality. Insect and disease damage is recorded as it occurs. The most important rating is the quality rating which is based upon overall appearance and desirability of the turf. The quality rating in this experiment takes into account density, coarseness, color, texture, disease damage, vigor and aesthetic value. Quality ratings are taken on a 1 to 9 scale with 1 equivalent to almost bare soil. A rating of 6 or greater is considered to be acceptable turf quality.

Results

The 4 year quality rating averages indicate that Warren's A-20, Merion, Belturf, Georgetown, Weibulls - 411, and 412, Fylking, Warren's A-34, NJE P-115

and a blend of Merion, Fylking and Pennstar have performed satisfactorily under Maryland climatic conditions (Table 1). Vantage, Sydsport, Primo, Kenblue, NJE P-5, NJE P-35 and Adelphi appear to be slow to establish good quality but develop rapidly after the establishment year. By the fourth year these cultivars all provided a turf of acceptable quality. Sixteen of the 43 clones tested did not provide acceptable quality turf in the fourth year after establishment (quality ratings less than 6).

Seasonal averages were misleading for some varieties, such as Kenblue, and Nuggett because they performed extremely well in only two or three months of the year and were of poor quality for the rest of the year (Table 2). Nuggett provided extreme fluctuations in quality because it became green late in the spring and was severely damaged by dollar spot in August and September. Newport, Vantage, Merion, Weibulls 411, Sodco, NJE P-115 and Georgetown continuously provided monthly quality ratings greater than 6 and exhibited good insect and disease resistance throughout the 4th year after establishment (Table 2).

Extreme fluctuations in quality from month to month usually indicates susceptibility to one or more turf pests. In this study severe attacks of Helminthosporium leaf spot occurred in June of 1972. Varieties such as Park, Geary, Jacklin S-21, WK-408, Minnesota 6, Kenblue, S. D. Certified, Zwartburg and Warren's A-10 were severely affected (Table 2).

In August 1972 Dollar Spot severely injured Nuggett, Palouse, Jacklins S-21, WK-408, WK-412, NJE P-114, NJE P-5, Adelphi, Zwartburg, Campus and PSU K-128.

Summary

The data indicates that only six of the 43 clones tested were capable of providing acceptable turfgrass quality from April through November of the 4th year after establishment. It appears that the greatest probability of obtaining maximum turf quality throughout the year is likely to come by blending two or three of the better performing cultivars. For every bluegrass cultivar new information is obtained each year on persistence, quality, and susceptibility

to disease and insects. Turfgrass variety recommendations for the State of Maryland and are influenced by the information obtained from this study.

Table 1. Quality ratings of Kentucky bluegrass cultivars maintained for 4 years at a 1½" mowing height at the Plant Research Farm near Fairland, Maryland.

Cultivar	4 Year Quality Rating by Year				4 Year Average
	1969	1970	1971	1972	
Newport	5.24	5.91	6.42	6.38	5.99
Vantage	4.53	6.12	6.28	6.58	5.88
Windsor	5.29	5.58	6.02	6.58	5.87
S. D. Certified	5.49	4.06	4.48	5.00	4.76
Arista	6.00	5.79	5.79	5.75	5.83
Sydsport	4.27	4.78	5.90	6.58	5.38
Nuggett	5.06	4.33	4.06	5.33	4.70
Palouse	5.37	5.45	5.23	5.08	5.28
Warren's A-34	5.24	6.37	7.35	7.04	6.50
Pennstar	5.39	5.66	5.80	6.33	5.80
Cougar	4.10	4.70	4.79	5.87	4.87
Park	5.47	5.41	5.43	4.86	5.29
Geary	5.13	4.91	5.09	5.17	5.08
Jacklins S-21	5.10	5.41	5.52	5.00	5.26
Fylking	6.09	7.55	6.39	6.59	6.66
Merion	5.43	5.66	6.52	6.96	6.14
Delta	3.81	4.08	4.09	4.75	4.18
Prato	5.56	5.00	5.43	5.46	5.36
Weibulls 408	5.26	5.70	5.84	5.13	5.48
Weibulls 411	5.53	6.04	8.23	6.98	6.69
Weibulls 412	5.47	5.70	6.55	7.00	6.18
Minnesota 6	5.26	5.00	5.25	6.38	5.47
Sodco	4.94	5.29	5.90	5.38	5.38
Primo	4.51	5.75	6.22	6.71	5.80
Kenblue	4.61	5.04	5.76	6.50	5.48
Belturf	5.77	6.20	6.16	6.17	6.05
NJE P-56	4.23	4.87	5.90	6.21	5.30
NJE P-114	4.89	4.99	5.59	5.92	5.35
NJE P-5	3.77	4.50	5.67	6.33	5.07
NJE P-35	4.23	5.25	6.69	6.54	5.68
Adelphi	4.71	5.16	6.27	6.25	5.60
NJE P-115	5.53	5.87	6.69	6.71	6.20
Georgetown	4.99	5.54	6.74	6.88	6.04
PSU K-107	5.41	5.79	6.12	6.21	5.88
Zwartburg	5.91	5.58	5.73	5.50	5.68
Campus	5.66	5.41	5.93	5.46	5.62
PSU K-182	4.91	5.16	6.00	6.25	5.60
PSU K-128	4.93	5.16	6.26	6.33	5.67
K8-146	5.63	5.50	5.80	6.00	5.73
K8-145	5.56	5.04	5.42	6.34	5.59
K8-144	5.51	5.25	5.80	6.38	5.74
Warren's A-10	6.33	3.91	5.54	5.75	5.38
Warren's A-20	6.23	6.58	8.09	7.00	6.98
Fyl, Penn	5.41	5.62	6.34	6.88	6.06

Table 2. 1972 Monthly Quality ratings of Kentucky bluegrass cultivars maintained for 4 years at a 1½" mowing height at the Plant Research Farm near Fairland, Maryland.

Cultivar	1972 Monthly Quality Ratings							
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Newport	6.0	6.0	6.7	6.7	6.7	6.3	6.0	6.7
Vantage	7.3	6.3	6.3	6.3	6.7	6.3	6.3	7.0
Windsor	7.0	5.3	5.3	6.3	6.7	7.0	7.3	7.7
S. D. Certified	5.0	5.3	4.7	4.3	5.3	5.0	5.3	5.0
Arista	4.3	5.7	6.7	6.7	6.7	5.3	5.3	5.3
Sydsport	7.3	7.7	8.3	7.3	6.7	5.0	5.3	5.0
Nuggett	3.7	6.0	8.0	6.7	5.3	3.3	4.3	4.0
Palouse	5.3	4.7	4.0	4.3	5.0	5.3	6.0	6.0
Warren's A-34	7.3	7.7	8.3	8.3	7.3	6.0	5.3	6.0
Pennstar	6.0	7.0	8.3	7.0	7.0	5.0	5.0	5.3
Cougar	5.3	6.7	6.3	6.7	6.3	5.3	5.3	5.0
Park	6.3	5.3	3.0	4.0	4.7	4.3	5.7	5.7
Geary	5.3	4.7	4.3	4.3	5.7	5.0	5.7	6.3
Jacklins S-21	6.3	4.3	2.7	4.3	5.0	5.0	6.3	6.0
Fylking	6.7	7.0	8.0	7.7	6.7	5.3	5.7	5.7
Merion	7.7	7.7	7.7	7.3	6.7	6.0	6.0	6.7
Delta	5.3	5.0	5.0	5.0	5.7	4.7	4.7	4.7
Prato	4.7	5.3	5.7	6.0	6.0	5.0	5.3	5.7
WK-408	6.3	4.7	4.0	4.0	5.0	5.0	6.3	5.7
WK-411	6.0	8.0	8.3	8.3	7.0	6.0	6.0	6.3
WK-412	6.0	7.3	8.0	7.7	7.0	4.7	5.0	5.3
Minn. 6	6.0	4.7	4.3	5.7	5.7	4.7	6.0	6.0
Sodco	7.3	6.7	7.3	6.3	6.7	6.0	6.3	6.3
Promo	5.7	6.0	6.7	7.0	8.0	6.7	6.0	6.0
Kenblue	7.3	4.7	4.3	4.7	5.3	5.7	7.3	6.7
Belturf	6.3	6.0	6.7	6.3	7.0	5.3	5.7	6.0
NJE P-56	7.0	6.7	7.7	7.0	6.3	4.3	5.3	5.3
NJE P-114	6.7	6.7	7.3	6.0	6.0	4.7	5.0	5.0
NJE P-5	6.7	6.7	7.3	7.3	6.3	5.3	5.3	5.7
NJE P-35	7.3	8.3	7.7	6.7	6.0	5.3	5.3	5.7
Adelphi	7.3	7.0	7.3	6.0	6.0	5.0	5.7	5.7
NJE P-115	7.7	8.0	7.0	6.0	7.0	6.0	6.0	6.0
R. I. PP-1	7.3	8.0	7.3	6.0	6.3	6.7	6.7	6.7
PSU K-107	6.7	6.3	7.3	6.3	6.3	5.3	5.3	6.0
Zwartburg	6.0	6.3	7.3	6.0	6.0	4.7	4.0	3.7
Campus	5.0	5.0	6.0	6.3	6.0	4.7	5.3	5.3
PSU K-162	7.3	6.7	6.3	5.3	6.0	6.0	6.3	6.0
PSU K-128	6.7	7.0	8.0	7.3	6.7	4.7	5.0	5.3
K8-146	6.3	5.7	6.0	6.3	6.7	5.3	5.7	6.0
K8-145	7.0	6.7	6.0	6.7	6.7	5.7	5.7	6.3
K8-144	6.7	6.0	6.0	7.0	7.3	5.7	6.0	6.3
Warren's A-10	7.7	5.7	5.0	6.0	6.0	5.3	5.0	5.7
Warren's A-20	7.3	8.3	8.7	7.3	6.7	5.7	5.7	6.3
Mer, Fyl, Penn	6.7	8.0	7.7	7.7	7.0	5.3	6.0	6.7
Bayes 5% LSD	1.27	0.86	1.00	1.00	1.42	1.43	1.37	1.97

Phenolic Response in Bluegrass Varieties Following Exposure to Ozone

G. A. Richards, C. L. Mulchi and J. R. Hall
Department of Agronomy

Purpose and Objectives

Stimulation of phenolic compounds have been observed in greenhouse grown bean plants (Phaseolus vulgaris) when compared to plants grown in a charcoal filtered-air environment. The increase in phenolic levels was attributed to the presence of photochemically produced oxidants in the non-filtered air. It was of interest to investigate the response of phenolic compounds in bluegrass varieties in an effort to correlate visual damage from ozone with biochemical activity in the damaged plants. Results from two greenhouse studies are presented in this report.

Procedures

In the fall of 1971, plugs were cut from several established bluegrass turf plots located at the Hopkins Farm and placed in the greenhouse. On September 10, 1971, three weeks after being placed in the greenhouse, five varieties including Adelphi, Kenblue, Fylking, Rhode Island PP-1 and Merion were exposed to 0.5 ± 0.03 ppm ozone for four hours in a fumigation chamber. The plants were rated for ozone damage seven days following their exposure. Clippings taken one day before and thirteen days following exposure were analyzed for total polyphenols. Nine weeks later, on December 17, 1971, six varieties including Arista, Nuggett, Newport, Merion, Fylking and Sydoport were exposed to similar ozone conditions. In the second study, clippings taken 24 hours before and 48 hours following fumigation were analyzed for total polyphenols. In both studies, three replications were employed for phenol analysis and five replications for visual

ratings. Visual damage ratings for both studies employed a scale of 0 to 10 with zero equaling no damage and 10 equaling approximately 50% of the leaf blades showing injury.

Results

Data from the September 10, 1971 study are summarized in Table 1. No significant differences in total polyphenol contents were found between clippings cut before and after the exposure; however, a slight rise in phenolic levels were noted. Kenblue and Adelphi showed an increase after fumigation but Fylking, Rhode Island PP-1 and Merion remained about the same. No varietal differences for phenolic contents existed prior to fumigation but significant differences were noted thirteen days after exposure suggesting a response to ozone. Merion and Adelphi varieties showed the most visible damage, Rhode Island PP-1 the least damage with Kenblue and Fylking appearing intermediate. No correlation was found between vegetation damage ratings and phenolic levels, $r = 0.28$, 0.05 and 0.27 for phenol levels before, after and difference, respectively.

In the December 17, 1971 study, significance at the 5% level was found between phenolic levels before and after exposure (Table 2). Arista, Nuggett and Fylking showed the most significant phenolic increases following fumigation with ozone. Prior to ozone exposure, varietal differences for phenolic contents were evident with Arista and Nuggett having the highest concentration. These two varieties likewise had the highest phenolic contents following exposure. Correlations of vegetation damage vs. phenols both before and following exposure were quite interesting, $r = 0.80$, 0.68 and 0.52 for before, after and difference, respectively. These results suggest that the presence of high levels of phenols in tissue prior to exposure tend to reduce the susceptibility of the plants to ozone damage.

Arista and Nuggett varieties had the highest phenol levels before exposure and showed the least vegetation damage during treatment. This observation has been reported with pathogenic organisms but this is the first case noted for nonpathogenic organisms and suggests further study should be made of the relationships between phenolic levels in tissue prior to fumigation and tolerance mechanisms to ozone.

Summary

There appears to be a relationship between initial phenol levels and tolerance of bluegrass varieties to ozone. This aspect certainly needs additional study to confirm the relationship. This may be variety dependent thus would not hold for all varieties.

There appears to be a relationship between vegetation injury and response to phenol production. Since phenol levels can vary in plants due to many factors, such questions as time to sample following fumigation, plant tissue to be sampled and exposure conditions needed to induce maximum response need to be answered before the relationship between injury and phenol response can be determined.

Table 1. Polyphenol levels of five Kentucky bluegrass varieties 24 hours before and 13 days following ozone exposure and visual damage ratings taken 7 days after exposure.[1/]

Bluegrass variety	Total Polyphenols, ug/ml[2/] Before[3/]	After	Difference[4/]	Damage rating[5,6/]
Adelphi	9.50a[7/]	11.70a	2.20	4.00 bc
Kenblue	7.40a	10.05ab	2.85	2.00ab
Fylking	9.45a	9.37ab	0.08	3.00ab
Rhode Island PP-1	8.17a	8.65 b	0.48	1.33a
Merion	8.27a	8.37 b	0.10	6.00 c
General means	8.56	9.67	1.14	3.27

1/ Ozone dosage was 0.5 ± 0.03 ppm for four hours.

2/ To convert to ug/mg plant tissue divide by 20.

3/ Average of three replications.

4/ No significant difference at the 5% level of probability was found between treatments employing the Duncan's Multiple Range Test.

5/ Damage expressed on a scale of 0-10: 0 = no damage, 10 = 50% of leaf blade showing injury.

6/ Average of five replications.

7/ Varietal means followed by same letter are not significantly different at 5% level within treatments employing the Duncan's Multiple Range Test.

Table 2. Polyphenol levels of six Kentucky bluegrass varieties 24 hours before and 48 hours following ozone exposure and damage ratings taken 7 days after exposure. 1/

Bluegrass variety	Total Polyphenols, ug/ml 2/			Damage rating 5,6/
	Before 3/	After	Difference 4/	
Arista	8.67a 7/	17.13a	8.46 *	0.33a
Nuggett	8.08ab	15.92a	7.84 *	0.66ab
Newport	4.98 b	9.17 b	4.19	1.00ab
Merion	4.53 b	7.40 b	2.87	2.66abc
Fylking	4.42 b	11.08 b	6.66 *	3.66 bc
Sydoport	4.30ab	8.40 b	4.10	4.66 bc
General means	5.83	11.52	5.69	2.16

1/ Ozone dosage was 0.5 ± 0.03 ppm for four hours.

2/ To convert to ug/mg plant tissue divide by 20.

3/ Average of three replications.

4/ No significant difference at the 5% level of probability was found between treatments employing the Duncan's Multiple Range Test.

5/ Damage expressed on a scale of 0-10: 0 = no damage, 10 = 50% of leaf blade showing injury.

6/ Average of five replications.

7/ Varietal means followed by same letter are not significantly different at 5% level within treatments employing the Duncan's Multiple Range Test.

* A significant difference at the 5% level between treatments was found employing the Duncan's Multiple Range Test.

Forage Double-Cropping Utilizing No-Tillage Planting

Lenat Hofmann
Department of Agronomy

Purpose and Objectives

Growing two crops on the same site in one season is a method by which farmers can increase crop production. This has been demonstrated on the Eastern Shore of Maryland where farmers practice double-cropping with winter barley and soybeans on the same field in one year. However, growing two crops instead of one usually results in shortening the normal growing season of at least one of the crops because planting the second one is delayed until the first can be harvested. Yields are usually reduced by delayed planting and costs are increased by planting and harvesting an additional crop. Therefore, one must determine if costs are compensated for by increased total production.

Recent innovations in minimum tillage reduce the time required for planting corn. This savings in time is an asset for double-cropping corn with another crop since the time from harvest of the first crop until the corn seed is in the ground is significantly reduced.

This experiment compares forage production from double-cropping systems to that of a one crop system, and compares a no-tillage method of corn establishment to conventional methods.

Objectives are to:

1. Compare double-cropped silage yields from small grain followed by corn to yields from a corn silage crop alone.
2. Compare silage production from corn established by no-tillage planting to conventional planting.
3. Compare production utilizing small grain for grain followed by corn for silage with the other systems.

Procedures

This experiment was established in the spring of 1970 at the University Agronomy-Dairy Forage Research Farm, Clarksville, Maryland on an Elsinboro silt loam. The experiment was replicated three times in a split-plot design with 3 planting treatments: early (full-season corn), medium (small grain for silage and corn for silage), and late (small grain for grain and corn for silage) as whole plots and a conventional planting and a no-tillage planting as sub plots.

On November 14, 1971, plots were disked and Balbo rye (for cover) was seeded to early plots, Jefferson barley (for silage) was seeded to medium plots, and Barsoy barley (for grain) was seeded to late plots. The rye cover was plowed down on conventional plots and killed with paraquat on no-tillage plots prior to planting the early corn treatment (May 14, 1972). Jefferson barley was harvested (June 7, 1972) for silage with a small plot forage harvestor. Barsoy barley did not survive the winter so these plots were overseeded with spring oats in spring. The sparse oat cover was removed before these plots were planted to corn. No tillage plantings were made in the small grain stubble and conventional plantings were made after stubble was plowed down and a seedbed prepared.

Fertilizer was applied once, just prior to preparing plots for corn planting. Each treatment received 195-130-130 lb/A N-P_2O_5-K_2O, respectively, broadcast (plowed down in conventional treatments) and 30-20-20 lb/A N-P_2O_5-K_2O, respectively, with the planter. All treatments received 1.25 lb/A atrazine and 1.25 lb/A simazine preemergent. In addition, no-tillage plots received 1/2 lb/A paraquat plus spreader.

Corn (Variety 3369A, Pioneer) was planted on May 30 for early treatment and June 14 for medium treatment. Corn was planted July 25 as a late treatment. Corn silage yields were obtained from six 40-foot rows per plot

harvested with a field harvestor on October 18. Corn grain yields were harvested by hand from a 40 foot row. Silage yields were calculated on a 35% dry matter basis and grain yields on a 12% moisture basis.

Results

Good rye stands and adequate Jefferson barley stands were obtained. Barsoy barley which would have been harvested for grain prior to double cropping with corn failed to survive the winter. The spring oats which was overseeded in the barley plot also produced a poor stand. Herbicide carry-over from the previous year appeared to cause the problem. Typical triazine injury symptoms were apparent on the new seedlings. These plots had received 1.25 lb/A atrazine and 1.25 lb/A simazine on July 8, 1971. Although the other plots received similar amount of these herbicides, the date of application was earlier; May 7 for early treatment and June 14 for medium treatment. Evidently the additional time was enough to permit some of the herbicidal residue to dissipate.

Corn planted on July 25 for a late treatment produced very poorly and had uneven stands, yield data were taken, but with an average silage yield of 3.5 ton/A for all late plantings, it was considered a crop failure. Data from this year and previous years indicated that double cropping corn for silage after a barley grain crop is not economically justified in Maryland.

Yields of full season corn were not significantly different for conventional or no-tillage plantings (Table 1). Comparing corn silage yields from early planting (May 30) and medium planting (June 14) also were not significantly different. However, under no-tillage the delay resulted in almost a 3-ton/A decrease. May 30 is later than the "normal" planting date for full season corn and yields were lower than expected. Prior experience in this study indicated that reductions do occur if corn planting is delayed from May 13 to the first week in June.

Total double-cropped forage yield was determined by adding barley silage yield to the medium corn silage yield. The conventionally planted corn system in the double-cropped treatment produced significantly higher forage yields than full season conventional corn. Under the no-tillage treatment, there were no differences between double cropped forage yields and full season yields. Since the time saved by planting corn utilizing no-tillage is a major consideration in applying double cropping to large acreages, these data would indicate double-cropping would not provide any yield advantage. Similar results were obtained the previous year.

Only one crop (corn) was fertilized utilizing either system. This places double-cropping at a disadvantage from the standpoint that additional fertilizer to the small grain in spring may raise small grain forage yield so that double cropping is economically justified.

Summary

1. Residual herbicide injury to fall-seeded small grain following late (July 8) atrazine and simazine application did not permit double-cropping barley for grain and corn silage. This practice does not appear to be economically justified in Maryland.
2. No significant corn silage yield differences were obtained whether corn was planted using conventional planting methods or no-tillage planting methods.
3. Forage production from double-cropped small grain and conventionally planted corn was significantly higher (4.7 ton/A) than late planted (May 30) full-season conventionally planted corn. No differences occurred between yields of double cropped forage or full-season corn when corn was planted by the no-tillage method.
4. Under the conditions of this experiment, there appeared to be no yield advantage from double-cropped forage over single-cropped forage production unless corn was planted conventionally.

Table 1. Tons/A (35% dry matter) forage from full season and double-cropped cropping systems using conventional and no-tillage planting practices.

Cropping System	Conventional	No-tillage	Average
Full season corn	15.6	16.9	16.2
Barley silage	5.1	4.5	4.8
Double-cropped corn silage	15.2	12.8	14.0
Total double-cropped forage	20.3*	17.3	18.8

* Significant tillage X cropping system interaction at .05 level of significance.

Effect of Diphenamid on Weed Control and Tobacco Seedling Production

J. H. Hoyert
Department of Agronomy

Purpose and Objectives

Diphenamid sold under the trade name of Enide has been very successful in controlling grass in field tobacco in Maryland and other areas. There has been considerable interest in the effectiveness of this material for use in controlling grassy and broadleaved weeds in tobacco plant beds. Diphenamid is very inexpensive and can be applied more conveniently and rapidly than materials now being used in Maryland. However preliminary work in the greenhouse indicated that there was some risk in injuring the tobacco seedlings at germination.

Objectives of this work were to study the effect of diphenamid for the control of grassy and broadleaved weeds in a conventional tobacco plant bed and determine the yield of seedlings pulled for transplanting. Special attention was paid to phytotoxicity effects of this material on germinating seedlings.

Procedures

The experimental design was randomized complete block with four replicates situated in the regular plant bed area of the Tobacco Experimental Farm on Monmouth sandy loam soil. Md. 609 variety was seeded on April 11, 1972 in a conventional manner. Irrigation was used frequently during the germination period.

The diphenamid was sprayed over the plots on April 11, 1972. Treatments were 0 lb/A; 2 lb/A (active); 4 lb/A (active); 6 lb/A (active) and 8 lb/A (active) with 40 gallons of water per acre used for each treatment. The 4 lb. rate is recommended for field use and would be expected to be the optimum rate in plant beds.

Plot size was 4.75 ft. x 9 ft. Data included the stand of tobacco seedlings and grassy and broadleaved weed count on May 16, 1972 and number of transplants pulled on June 19 and June 30, 1972.

Results

Table 1 presents a summary of results from 1972. All rates of diphenamid were better than the control in the number of good transplants drawn for field use. There were no injury symptoms apparent at any of the rates of diphenamid tested. The material was effective for grassy weed control with all rates being superior to the control. Diphenamid gave some control of broadleaved weeds with all rates being superior to the control. There were no differences between the various rates used.

Summary

In 1972 diphenamid gave satisfactory grassy and broadleaved weed control. All rates of the material were better than the control in the number of good transplants drawn for field use. There were no significant differences among the rates of diphenamid.

Table 1. Effect of diphenamid on weed control and tobacco transplant production. 1972.

Diphenamid lbs. per acre/active	Count			
	Grass per sq. yd.	Bdlf. Weeds per sq. yd.	Tobacco Seedling Stand per sq. yd.	Tobacco Transplants Drawn per 100 sq. yds.
0	33.0	81.0	117	3,460
2	3.2	13.6	284	8,140
4	0.2	7.0	315	8,410
6	0.2	3.7	333	9,998
8	0.2	3.0	329	8,085
L.S.D. (.05)	56	13.0	108	2655
(.01)	78	18.1	153	3690
C.V.	10.4%	39%	25.6%	22.4%

Effect of Sucker Control Agents, Method of Application and Time of Harvest on Maryland Tobacco

J. H. Hoyert
Department of Agronomy

Purpose and Objectives

Maryland growers have converted to the use of sucker control chemicals in the past few years. There are practical problems in the application of suckering agents brought on by the reliance of many large growers on custom operators. It is necessary for the custom operator to treat the grower's total tobacco acreage in one visit as it would be too costly to make repeat visits to the farm. It is often impossible for the grower to top his entire crop before the applicator visits because of labor restrictions. Thus there are practical advantages for custom operators to apply sucker control agents to untopped tobacco.

Another problem resulting from decreased labor availability is that tobacco is now harvested over longer periods of time after topping which could have a significant effect on quality and yield. Maryland leaf is noted for its thin body and high filling power -- quality characteristics that must be preserved.

Systemic sucker control agents are most popular in Maryland but contact type chemicals have some place on small crop acreages. Combinations of systemic and contact sucker control agents have proven profitable in the flue-cured area and should be investigated under Maryland conditions which are considerably different than flue-cured.

Consequently this study was initiated to compare sucker control agents and different methods of application. The objectives were:

1. To compare chemical suckering agents and various methods of application of these suckering agents and their effect on sucker control, yield, price and acre values and filling capacity of Maryland tobacco.
2. To determine the effect of time between treatment and harvest for various sucker control methods on yield, price and acre values, sucker control and filling capacity.

Procedures

This experiment was located on a Monmouth fine sandy loam at the Tobacco Experimental Farm. Md. 10 variety was transplanted at a population of 6,223 plants per acre with 70-120-180 lbs. of fertilizer broadcast per acre. Four replicates were used in a split plot design with the time of harvest as whole plots and sucker control methods as the sub plots.

Transplanting was carried out on June 8, 1972 and topping was completed August 9, 1972 when approximately 70% of the plants showed open flowers.

Treatments were:

1. Control -- Topped August 9, 1972 with no sucker control used.
2. Systemic -- Topped August 9 and sprayed with MH-30 at 1 pint per 1000 plants.
3. Systemic -- MH-30 at 1 pint per 1000 plants sprayed on August 4 and topped August 9.
4. Contact -- Topped August 9 and Off-Shoot-T applied.
5. Sequential -- Off-Shoot-T applied August 4, topped on August 9 and sprayed with MH-30.

There were two harvest dates of August 21, 1972 and August 30, 1972. At the time of harvest suckers were removed from the plot and weighed to determine the effectiveness of sucker control.

Yield, price per pound and acre values were computed for the cured leaf using the standard grades as established by Tobacco Division of the Consumer and Marketing Service of the U. S. D. A. Filling capacity was determined as an indicator of the leaf's ability to fill a cigarette.

Results

Rainfall was near optimum during the 1972 season and sucker growth was heavy. The 1972 results are summarized in Table 1.

All suckering agents and methods resulted in higher yields than the control treatment. The earlier harvest date gave somewhat more yield than the later date but this wasn't significant. This difference was primarily because of the control treatment where sucker growth reduced yields by 390 lbs. per acre in the later harvest.

There was no effect on price per cwt. of the cured leaf by either suckering methods or time of harvest.

Acre values were higher for all suckering agents than for the control treatment. No significant differences resulted between the two harvest dates. The control treatment at early harvest gave $1320 per acre, however by the late harvest, sucker growth competition was so profuse that the acre value decreased to $1025 per acre. Much of this reduction was because of "firing" and loss of lower leaves.

Measurement of both sucker numbers and weights were much greater for the control treatment than any of the suckering agents. There was greater sucker growth when maleic hydrazide was applied before topping than for the other suckering agents.

Filling capacity was not changed by any of the suckering methods used in this experiment. However the late harvest date resulted in a higher filling capacity than the early harvest. There was a trend toward higher filling capacity for those treatments where sucker growth was greater.

Summary

All suckering methods resulted in higher yields and acre values of cured leaf than the control treatment. Sucker control was better for all suckering methods than the check treatment. There were more suckers present where maleic hydrazide was used before topping than for the other suckering agents used. The late harvest date resulted in higher filling capacity measurements than the early harvest.

Table 1. Effects of sucker control treatments and time of harvest on sucker weight, yield, price and acre values of Maryland tobacco. 1972.

Table 1. Effects of sucker control treatments and time of harvest on sucker weight, yield, price and acre values of Maryland tobacco. 1972.

Treatment	Yield /Acre Lbs	Price $/Cwt	Acre Value $/A	Suckers % Control	Suckers Weight /Plot Lbs	Suckers Number /Plot	Filling Capacity cc/gm
Between Chemical Treatments							
1. Control	1498	78.39	1171	0	15.66	172	6.3
2. Maleic hydrazide at topping	1695	77.50	1316	82	2.84	52	5.8
3. Maleic hydrazide before topping	1700	77.92	1325	59	6.41	135	6.0
4. Contact	1800	77.25	1389	77	3.58	45	5.9
5. Contact before topping maleic hydrazide at topping	1730	77.45	1332	97	0.41	18	5.7
L.S.D. .05	150	N.S.	99		6.67	75	N.S.
.01	204	N.S.	134		----	104	
C.V.	8.7%	0.3%	7.3%		112%	87%	24.8%
Between Dates of Harvest							
Aug. 21, 1972	1726	77.48	1337		1.45**	39**	5.7*
Aug. 30, 1972	1640	77.92	1277		10.10	130	6.1
C.V.	11.2%	0.9%	10.9%		38.3%	49%	7.6%

* Differences significant at .05 confidence level.
** Differences significant at .01 confidence level.

Regional Tests With Tobacco Sucker Control Agents on Maryland Tobacco

J. H. Hoyert and G. L. Steffens
Department of Agronomy and
Plant Physiology Institute, U.S.D.A.

Purpose and Objectives

Plant growth regulators have been used to inhibit the growth of tobacco suckers in all types of tobacco. However, some undesirable effects on the chemical and physical properties of the tobacco and possibly the health of consumers have been suggested. Consequently, studies have been going on for some time on a regional basis to find other chemicals and methods of sucker control which would be more suitable. (This approach has been through the Regional Tobacco Growth Regulator Committee which involves 10 states, U.S.D.A., EPA, many chemical companies, most of the domestic tobacco companies and one foreign tobacco company. This regional research was instigated by the U. S. House of Representatives).

Maryland is a participant in this regional research and the report herein will deal with 1972 results in Maryland to determine the effectiveness of several sucker control agents on tobacco yield, price, acre values and sucker control.

Procedure

The experiment was conducted on a Monmouth fine sandy loam at the Tobacco Experimental Farm. Md. 10 variety was transplanted on June 8 with 60-120-180 lbs. of fertilizer broadcast per acre and an additional 20 lbs. of nitrogen sidedressed 30 days after planting. Topping was completed on August 10 when 90% of the plants showed at least some open flowers. Suckers were removed after 14 days, counted and weighed. The control

treatment which was not suckered served as a basis for calculating the percent sucker control. Treatments studied were: control, maleic hydrazide, Off-Shoot-T, American Cyanamid-390, Penreco-98B, Am Chem A-820, Penn Walt TD-6587, Emory 1601 and Imperial Chemical PP-938.

Results

Significantly higher cured leaf yields and acre dollar values were obtained from tobacco treated with all of the sucker control agents as compared to values from the untreated control as shown in Table 1. There were no significant differences in the price per hundredweight between any of the treatments. However there was a slightly higher price for tobacco from the untreated control plots. Control of suckers was excellent for all suckering agents when compared to the untreated check. Percent control ranged from 86 to 98 percent. There were no leaf injury symptoms observed for any of the treatments in 1972. Phytotoxic effects frequently occur with the use of some suckering agents.

Summary

Regional sucker control tests were conducted on Maryland tobacco to determine the effectiveness of various suckering agents on degree of sucker control, yield, price and acre values of tobacco. All of the suckering materials gave very satisfactory control. Significantly higher yields and acre values resulted from all chemicals tested when compared to the untreated check. There were no important differences in price per hundredweight for tobacco from any of the treatments including the control treatment.

Table 1. The Effects of Sucker Control Treatments on Sucker Growth, Cured Leaf Yield and Price -- Maryland Tobacco Advanced Regional Tests. 1972.

Treatment	Sucker Growth				Cured Leaf		
	Sucker Control[1/] %	Weight /Plant gms	Weight /Sucker gms	Suckers /Plant No.	Yield /Acre Lbs	Price $/Cwt	Acre Value $/A
Control	0	254.0	22.3	12.6	1504	82.82	1246
MH	96	10.6	5.9	1.5	1708	81.65	1397
OST	96	3.6	21.8	0.4	1782	81.34	1455
AC-92390	97	8.7	3.2	1.3	1762	82.45	1452
PX-98B	98	5.8	10.3	0.7	1786	82.12	1487
A820	98	2.3	3.1	2.7	1722	81.25	1399
TD-6587	97	7.2	4.1	0.9	1860	81.90	1525
1601	96	6.7	15.6	1.3	1853	82.11	1521
PP-938	86	34.3	26.1	1.4	1835	81.99	1504

[1/] % by which treatment reduced sucker green weight compared to check.

The Feasibility of Transplanting Tobacco Seedlings in Pressed Peat-Soil Cubes

J. H. Hoyert
Department of Agronomy

Purpose and Objectives

The purpose of this research was to develop new methods of growing tobacco plants which would have a potential for improving seedling uniformity. Thus, if successful, further mechanization of transplanting and a reduction in labor might be achieved. Irregular tobacco at harvest time because of non-uniform transplants is one of the major problems in total mechanization of tobacco production.

The objectives of this study were:

1. To compare the growth and uniformity of transplants in pressed peat-soil cubes to conventional transplants.
2. To investigate the feasibility of discontinuing the use of water with peat-soil cubes.

Procedure

This experiment was situated on a Monmouth sandy loam soil at the Tobacco Experimental Farm. Md. 609 variety was transplanted using a modified Ellis 2-row mechanical transplanter at a plant population of 6,223 per acre. Fertilizer was broadcast at a rate of 60-120-180 lbs. per acre. Experimental design was a randomized complete block with 4 replicates. Plots were 1-row of 32 plants or 3 by 74.6 ft. in size with 30 plants harvested.

Treatments included were pressed peat-soil cubes and transplants pulled from a plant bed and carefully sorted and selected according to uniformity of size and shape. The control consisted of conventional trans-

plants pulled rapidly as an average grower draws seedlings with no extra attention given to uniformity. Each of these treatments were transplanted with 1/2-pint of water placed at the roots during the planting operation. The three treatments were also repeated with no water used at transplanting making a total of six treatments.

Transplanting was carried out on June 6, 1972. This period was one of adequate and well distributed rainfall and soil moisture was at an optimum level. Harvesting was completed on August 11, 1972.

Ratings of early growth, vigor and uniformity were made 3 weeks after transplanting by four observers on a 1 to 10 basis with 10 being a perfect plot. Estimates of relative uniformity were based on plant to plant variation within individual plots using measurements of the cured tobacco. Yield per acre, price per hundredweight and acre values were also determined.

Results

The field results are presented in Table 1 and indicate that under the conditions of ideal soil moisture at time of transplanting there were no significant differences between any of the treatments for early growth ratings or acre value. Trends in yields and price were inconclusive. Thus under optimum moisture conditions the cube transplant method is equal to the conventional system of transplanting by these agronomic parameters.

Summary

The peat-soil cube performed satisfactorily under these conditions of optimum soil moisture. This method would be suitable for general farm use if it proves economically feasible. The agronomic feasibility of this system over variable seasons remains to be demonstrated.

Table 1. Yield, price, acre value and early growth rating of various types of tobacco transplants, 1972.

Treatment	Yield lbs/A	Price $/cwt.	Value $/A	Rating of early growth *
(with water)				
Control	1492	81.29	1212	7.86
Peat-soil cube	1550	81.12	1258	7.14
Selected plant	1579	80.65	1274	7.85
(without water)				
Control	1612	80.78	1302	7.10
Peat-soil cube	1494	81.25	1214	7.16
Selected plant	1413	79.47	1124	7.48
L.S.D. (.05)	72.9	1.11	N.S.	
(.01)	101.0	1.54	N.S.	
C.V.	3.2%	1.0%	6.3%	

* Rating of 1 to 10 with 10 being optimum.

The Use of 2-Chloroethylphosphonic Acid (CEPA) to Improve Maturity of Maryland Tobacco

J. H. Hoyert
Department of Agronomy

Purpose and Objectives

There is need for work on reducing the range of maturities between the lower and upper leaves of the tobacco plant at harvest time. Maryland tobacco is stalk-cut at that critical time when the middle leaves are of optimum ripeness, the lower leaves are overmature and the top leaves are immature. This wide range is a limiting factor to new procedures of harvesting and curing being developed for labor reduction. The chemical growth regulator 2-chloroethylphosphonic acid had shown some promise in previous observations of improving maturity. It was thought that further work was desirable with this material. This chemical will be listed herein as CEPA and is now labeled as Ethephon.

The objective of this study was to compare the effect of maturity at time of application upon the yield, price, acre values and filling capacity of cured tobacco when treated with CEPA.

Procedure

This study was located on a Monmouth sandy loam soil at the Tobacco Experimental Farm. Md. 609 variety was planted at a population of 6,223 plants per acre with 60-120-180 lbs. of fertilizer broadcast per acre. An additional 40 lbs. of N was sidedressed 3 weeks after planting to compensate for early high rainfall. The design was a randomized complete block with four replicates. Plots were planted on June 7, 1972 and topped on August 4, 1972 with a contact chemical used as a sucker control agent. Untreated

check plots were harvested for chemical analyses but yield performance was not recorded.

CEPA was applied at the rate of 75 mg per plant. Treatments were as follows:

Treatment	Time of Application	Time of Harvest
1	Aug. 4, 1972	Aug. 8, 1972
2	Aug. 10, 1972	Aug. 15, 1972
3	Aug. 14, 1972	Aug. 18, 1972
4	Aug. 18, 1972	Aug. 22, 1972
5	Aug. 23, 1972	Aug. 28, 1972
6	Aug. 29, 1972	Sept. 1, 1972

The chemical was added to water to bring total volume up to 20 ml per plant and sprayed in a fine mist over the entire plant. The test was designed to be harvested 3 to 4 days after treatment with CEPA. The variation in time of application was to determine the effect of maturity of the plant upon response to CEPA.

Results

Table 1 presents the yield, price, acre values and filling capacity of tobacco in 1972. Yield, price and acre values were decreased at the August 8 harvest date. This early harvest date resulted in small immature leaves in the upper part of the plant. The trend from second harvest date through the last date of harvest show increases in yield, price per hundredweight and acre values. This trend is believed to be because of maturity. The August 22 harvest date (treatment #4) was unexplainably lower than expected from the trend. An opposite picture was noted for filling capacity as this decreased steadily from the second harvest through the last harvest date.

Yellowing of leaves was noticed after the CEPA application from the second treatment through the last treatment giving the plant a "ripe" appearance. Curing of matured tobacco treated with CEPA was about 5 to 7 days earlier than the untreated tobacco. However the midribs of the leaf did not dry any faster than the control tobacco.

Summary

The application of 75 mg per plant of CEPA caused a yellowing of the treated leaves of mature plants. The immature plants of treatment 1 did not yellow as a result of CEPA applications. CEPA treated mature tobacco "yellowed-down" uniformly and completely within 3 days in the curing barns and the leaf lamina cured 5 to 7 days earlier than untreated tobacco. Midribs of these leaves dried at the same rate as the untreated tobacco. This increased curing rate would offer a potential in mechanization of allowing the curing facility to be used twice in a single season.

Trends indicate that increased maturity improved tobacco yields, price and acre values.

Table 1. Effect of CEPA on yield, price, acre values and filling capacity of Maryland tobacco. 1972.

Treatment	Yield lbs/A	Price $/cwt.	Value $/A	Filling capacity cc/gm
1	1458	80.76	1178	6.68
2	1680	82.82	1391	7.13
3	1713	82.44	1412	6.83
4	1566	82.17	1287	6.80
5	1889	82.06	1550	6.63
6	1943	80.98	1574	6.58
L.S.D. (.05)	249	1.25	212	N.S.
(.01)	346	N.S.	294	N.S.
C.V.	9.8%	1.0%	10.1%	8.9%

Chemical Topping Studies

C. G. McKee
Department of Agronomy

Purpose and Objectives

To investigate the potential of chemicals for topping Maryland tobacco. Contact-type chemicals have long been used for sucker control in the tobacco area. If a contact acting chemical can be satisfactorily used to kill the flower bud, it would save one operation that is now carried out by hand.

Procedure

The chemical-topping studies were set up with three treatments: chemical topping using 1-decanol, chemical sucker control using T-148, and a check with no sucker control. The chemical topping and the chemical sucker control treatments were applied to the plants at the early bud stage. The check was allowed to flower normally and was topped at the medium bloom stage.

Results

The results for the chemical topping test are summarized in Table 1. The chemical topping treatment resulted in the highest yield and gross dollar return. The chemical sucker control treatment had a higher yield and gross dollar return than the check treatment.

Summary

The results from this test indicate that 1-decanol can be satisfactorily used to kill the terminal bud and thus "top" tobacco. The chemical also gives sucker control. However, the major problem with this chemical is the necessity for very precise application. The manufacturer of the chemical has been unable to design equipment that will apply this material

in a satisfactory manner and have thus ceased work with this material as a chemical topping agent. Therefore, this experiment was terminated with this years work.

Table 1. Effect of Chemical Topping on Performance of Maryland Tobacco.

Treatment	Yield lbs/acre	Price/lb cents	$/Acre
1. Chemical topped	2246	74.2	1666
2. Chemical sucker control, T-148	1896	75.8	1437
3. Check	1463	76.0	1112

Irrigation with Maryland Tobacco

C. G. McKee
Department of Agronomy

Purpose and Objectives

Previous research has indicated that the investment in irrigation equipment can be justified on most tobacco producing farms in Southern Maryland. The number of acres of tobacco that is presently irrigated is still relatively small -- about 15% of the total, but it is increasing every year. Previous work also indicated that some varieties respond differently than others to higher nitrogen levels when adequate moisture is available.

The objective of this research is to determine the differential response of the released Maryland varieties and advanced breeding lines to nitrogen levels under optimum soil moisture conditions.

Procedures

The experiment was a split-split-plot design. Main plots were irrigation vs. no irrigation. The first split was nitrogen rate -- 70 and 100 pounds per acre and the second split was variety -- Md. 10, Md. 609, Md. 64 and breeding lines 872, 231 and 37F. There were four replicates for a total of 96 plots.

The experiment was located at the University of Maryland tobacco Experimental Farm. The soil was Monmouth fine sandy loam. The initial fertilizer application of 60 lbs. nitrogen, 120 lbs. P_2O_5 and 180 lbs. K_2O was broadcast and disked in prior to planting. The additional nitrogen necessary was applied as a sidedressing 2 weeks after transplanting.

Water was applied to the plots requiring irrigation when the plants were starting to show slight wilting in the heat of the day. A Skinner irrigation system was used that applied approximately 1/4 inch of water per hour.

Results

The 1972 growing season was very wet in the early part and dry in the later part. Water was applied to the irrigated plots 3 times in August for a total of $3\frac{1}{2}$ inches.

The results for 1972 are given in Table 1. Irrigation at the low level of nitrogen was detrimental to both per acre yield and dollar return. However, irrigation coupled with the high nitrogen rate resulted in an increase in per acre yield and dollar return. Irrigation also increased leaf burn and filling capacity and reduced total nitrogen and alkaloids, all of which are desirable. The varieties and breeding lines tested all fell into normal ranges for Maryland tobacco in per acre yield and dollar return.

Summary

On the irrigated plots at the high nitrogen rate there was an increase in the yield and dollar return from tobacco. With the low rate of nitrogen, irrigation reduced both yield and dollar return. Irrigation tests must be conducted over a number of years to determine the response on a long term basis. This project on irrigation will be continued next year.

Table 1. Summary of Irrigation Test

Table 1. Summary of Irrigation Test -- 1972.

Treatment	Yield/Acre lbs	Cents/lb	$/Acre	Burn seconds	Filling Capacity cc/gm	% Total Nitrogen	% Total Alkaloids
Irrigated	1505	78.2	1189	10.0	7.39	2.35	1.33
Not Irrigated	1496	77.9	1165	5.6	6.89	2.73	1.90
Low N	1409	77.9	1109	8.4	7.28	2.39	1.50
High N	1591	78.2	1245	7.2	7.00	2.69	1.73
Variety							
Md. 10	1317	77.0	1016	8.2	7.04	2.44	1.72
Md. 609	1481	79.4	1160	9.8	7.41	2.79	1.60
Md. 64	1740	76.7	1335	8.4	7.03	2.42	1.45
BL 872	1559	78.6	1226	7.2	7.31	2.42	1.38
BL 231	1551	78.9	1224	8.6	7.21	2.67	1.47
BL 37	1410	77.9	1098	4.7	6.84	2.51	2.06
Interaction							
Low N Irrigated	1369	78.0	1090	10.9	7.61	2.21	1.20
Low N Not Irrigated	1449	77.9	1128	5.9	6.95	2.58	1.79
High N Irrigated	1640	78.5	1288	9.0	7.17	2.50	1.45
High N Not Irrigated	1543	78.9	1201	5.4	6.83	2.28	2.02

Testing Lodging Resistance of Maryland Tobacco Varieties

C. G. McKee and M. K. Aycock, Jr.
Department of Agronomy

Purpose and Objectives

To investigate the potential of using wind making machines to test the lodging resistance of tobacco varieties. Md. 609 variety, which accounts for over 60% of the total acreage of Maryland tobacco is very susceptible to lodgings. This has created a lot of interest among growers for developing a new variety similar to Md. 609, but with better resistance to lodging. Lodging resistance is often difficult to determine in normal testing procedures for breeding lines.

Procedure

Three Maryland varieties, Md. 10, Md. 609 and Md. 64, with some known history of root system and lodging resistance and one Md. 609 type breeding line, BL 872, were planted in a field test. Single row plots were used with 8 replications. When the plants had started to come into flower, a large mist blower type sprayer was used to provide "wind" to blow directly into the single row plots. Estimates of the angle of lean of the individual plants to the ground were then made.

Results

Results for the wind resistance study are summarized in Table 1. Md. 609 with a known poor resistance to lodging had the greatest average lean with 72 degrees (90 degrees being no lean). Md. 10 had an average lean of 78 degrees and this variety is considered moderate in lodging resistance. Md. 64 with an average lean of 85 degrees is considered by growers to have good lodging resistance. BL 872, the Md. 609 type line, had an average lean of 86 degrees. This was significantly better than Md. 609 and similar to Md. 64 which has good resistance to lodging.

Summary

The results from this study would indicate that field testing for lodging resistance can be successfully done with wind making machines. This will allow us to check the lodging resistance of potential tobacco varieties prior to release.

Table 1. Summary of Lodging Resistance Test with Maryland Tobacco - 1972.

	Average angle of plant to ground
Md. 609	72°
Md. 10	78°
Md. 64	85°
BL 872	86°
L.S.D. (.05)	8
(.01)	11
C.V.	9.7%

Response of Corn to Various Tillage Practices

F. P. Miller
Department of Agronomy

Purpose and Objectives

The purpose of this study is to evaluate the response of corn to several methods of soil preparation and tillage. The tillage practices include subsoiling at three spacings, plow-planting, and no-tillage planting under several conditions, viz., no pre-preparation, disking ahead of the no-till planter, and plowing-disking ahead of the no-till planter.

Procedures

This study is located on the Bertie silt loam (somewhat poorly-drained) and Mattapex silt loam (moderately well-drained) soils. Four replications were used throughout and the plot size was 50 x 20 feet. The corn variety was Pioneer 3369A planted in 30 inch rows on May 18. The no-tillage corn was planted with a modified four-row I.H. planter, and the conventionally planted corn utilized a four-row J.D. planter.

The cultivated plots were plowed and disked on the day of planting. Likewise, the subsoiling was done on May 18 to a depth of 23 inches at three spacings: 22, 44, and 80 inches, respectively. The plots planted with the no-tillage planter were either left untreated, disked only, or plowed and disked (check).

Fertilizer was applied in accordance with soil test results and a yield goal of 150 bushels per acre. Prior to plowing on May 18, a broadcast fertilizer application was made at the rate of 120 - 60 - 60 (lbs per acre of N - P_2O_5 - K_2O). An application of 30 - 60 - 60 (lbs per acre of N - P_2O_5 - K_2O) was made in the row with the conventional planter. On the plots planted

with the no-tillage planter, a top dressing of NH_4NO_3 at the rate of 30 pounds of N per acre was applied after the corn had germinated. Thus, the total fertilizer application for the corn planted with the conventional equipment was 150 - 120 - 120 (lbs per acre of N - P_2O_5 - K_2O) and the total for the plots planted with the no-tillage planter was 150 - 60 - 60 (lbs per acre of N - P_2O_5 - K_2O).

A combination herbicide was applied to all plots, including the no-tillage plots, on May 18 at the rate of 1.5 pounds of atrazine (AATREX) and 1.5 pounds of alachlor (LASSO) per acre. Although no cover crop was planted on the no-tillage plots, a heavy infestation of chickweed was present along with the residue and corn stover from the previous year's crop. These no-tillage plots, in addition to the aforementioned herbicide treatments, received an application of paraquat at the rate of 0.5 pound (one quart) per acre also on May 18. The no-tillage corn was planted into the previous year's corn stover and indigenous weed cover.

Results

The results for the 1972 subsoiling and plow-plant treatments are presented in Table 1. The data also include the yields for the period 1967-71.

The average yields are lower than the previous years' yields due primarily to the effects of the prolonged wetness caused by Hurricane Agnes. As in previous years, there has been no beneficial effect on corn yields from the subsoiling treatments. After 6 years of subsoiling these plots, not only has there been no beneficial result in terms of yields, but there has been a trend toward lower yields for the subsoiling treatments as compared to the conventional check. As noted in previous reports on this work, this trend toward lower yields is perhaps the result of compaction of the soil due to the increased traffic necessary for the subsoiling operation.

Seldom, if ever, would these deep, silty soils be dry enough in the spring to allow the subsoiler to shatter the profile and reduce the bulk density. Only where there is a shallow, brittle plow-pan or hard pan that is reachable by the subsoiling shank is there any beneficial result from subsoiling. Even in these soils, however, the maximum benefit seems to occur at the lowest moisture content.

The greatest compaction should occur in the 22 inch spacing since the tractor wheels must pass immediately adjacent to the previous wheel track. The 44 and 80 inch spacings should have less compaction. This trend is only slightly evident between the three subsoiling treatments from the six year mean, although there is a greater yield reduction for all subsoiling treatments when compared to the check.

After six years of observing subsoiled corn yields on these plots, it is obvious that subsoiling is not a beneficial practice on these silty soils which exhibit no plow pan or hard pan. Any beneficial effect the subsoiling may have seems to be more than offset by the compaction caused by increased traffic required by the subsoiling operation. Only where soils contain hard pans reachable by subsoilers or have consistencies at low enough moisture contents to be broken long enough by subsoiling to enhance the rooting environment does the practice of subsoiling appear beneficial. On the silty soils used herein, representing thousands of acres of Coastal Plain soils, subsoiling does not appear to have any beneficial effect after six years of the practice. This year terminates this subsoiling demonstration.

The plow-plant treatment still appears to be an alternative on these silty soils. After five years of this continuous treatment (Table 1), only slight yield reductions have been observed when compared to the check. This treatment will be continued.

The no-tillage treatment data are presented in Table 2. The four year mean suggests that planting no-tillage corn in the previous year's corn stover is an alternative on these soils.

It must be pointed out, however, that a heavy growth of chickweed occurs on these plots every spring and adds significantly to the vegetative cover which is necessary for the success of the no-tillage system. If a corn field were free of weeds at the time of planting, the previous year's corn stover does not appear to provide enough soil cover to simulate no-tillage production with a cover crop.

This observation can be illustrated in the 1971 data (Table 2) where the cover crop (rye) was cut and removed. Planting into the stubble resulted in a poor stand and yield. There was not enough cover to retain the early surface moisture and reduce the surface temperatures which appear to be necessary to the success of no-tillage corn production. Retaining the rye cover increased the yield by 41 bushels over the stubble plots and 24 bushels over the conventional check plot, again illustrating the importance of the cover crop in the success of no-tillage corn production.

The herbicide combination appears to have reduced the fall panicum weed problem to tolerable limits. Fall panicum still, however, is the major weed which appears during the growing season.

Summary

After six years of subsoiling, no beneficial effects have been noted as measured by corn yields. On the contrary, there has been a trend toward reduced yields under the subsoiling treatment on these silty soils due, most probably, to the compaction by the subsoiling tractor and equipment. Unless there is a hard pan and/or brittle soil consistance which can be subsoiled at low moisture levels, subsoiling does not appear to provide any

enhancement of the rooting environment. In these silty Bertie and Mattapex soils, neither of these conditions prevails. Thus, subsoiling these soils appears to be an exercise in futility.

No-tillage corn production on these soils without a cover crop appears to be feasible only if a heavy corn stover and weed infestation provides the soil cover required in no-tillage production. After four years of production, the no-tillage plots have yielded as well as the conventionally planted plots where there was adequate vegetative cover between the row.

Table 1. Average corn yields for the period 1967-72 for four soil management treatments - Wye Institute, Maryland.

Treatment	Average yield bu/Acre						
	1967	1968	1969	1970	1971	1972	Mean
Check	112	118	130	122	125	112	120
Subsoiled 22 inches	115	105	103	101	97	98	103
Subsoiled 44 inches	115	116	123	97	115	94	110
Subsoiled 80 inches	112	98	113	116	106	93	106
Plow-planted	-	98	120	120	114	105	111

Table 2. Average corn yields for no-tillage treatments as compared to conventional planting - Wye Institute, Maryland.

Treatment	Average yield bu/Acre				
	1969	1970	1971*	1972	Mean
Check; plowed, disked	125	110	88	94	104
Disked only	131	120	65	90	101
No-tillage (corn stover)	136	102	71*	100	102

*In 1971, a rye cover crop was planted in the fall of 1970. To simulate no-tillage planting with no cover crop, the rye was cut and removed. The corn was then planted into the rye stubble. Where the corn was planted into the rye cover crop, the yield averaged 112 bu/Acre. The low yields resulted primarily from poor stands caused by the no-tillage planter being adjusted for planting in a cover crop.

Analysis of Air Pollution Effects on Maryland Type Tobacco Varieties and Hybrids

Rossana Hsieh, C. L. Mulchi and M. K. Aycock, Jr.
Department of Agronomy

Purpose and Objectives

Preliminary field and greenhouse studies on the effects of air pollution on Maryland tobacco varieties and hybrids have shown that a wide range in tolerance to air pollution exists among varieties and hybrids. In an effort to further characterize these varieties for their tolerance to air pollution under field conditions and to obtain genetic information which would be useful in a breeding program to improve the tolerance to air pollution, studies were conducted at three locations in southern Maryland during 1972.

Procedures

The field study consisted of a diallel set of crosses containing eight parent varieties (Catterton, Wilson, Gertz, Moore, Md. 59, Md. 10, Md. 64, Md. 609) and their twenty-eight hybrids. The hybrids were obtained by crossing the parent varieties in all possible combinations excluding reciprocals. The three field locations were Upper Marlboro, Davidsonville and Dentsville which are 15 miles east, 23 miles southeast and 50 miles south-southeast of Washington, D. C., respectively. A randomized complete block design with three replications was used at each location. Each plot consisted of a single row with twenty-five plants spaced two feet apart. Established cultural practices were followed in the growth of the plants.

In mid August, weather fleck ratings were made on 10 competitive plants within each plot. Fifteen leaves on each plant beginning at the bottom, were scored on a basis of one to five. A one indicated a leaf was free of fleck symptoms while a five indicated severe flecking over the entire leaf surface. Thus, the score for each plant ranged from 15 to 75.

Results

The genetic information from the field studies are summarized and compared with information previously obtained in a greenhouse study conducted under controlled conditions (Crops and Soils Research, 1971).

The general ranking of the parent varieties and their hybrids observed in the field study was very similar to the results from the greenhouse study with only a few exceptions. The data shown in Table 1 is a summary of both the greenhouse and field studies for mean weather fleck data of the varieties and hybrids and the heterotic response of the hybrids. Heterosis is the percent difference of the hybrids from the parent averages. The parent varieties in both studies showed a range of tolerance to air pollution with the hybrids showing somewhat greater damage than the parents indicating heterosis toward the susceptible side. Location appeared to influence the degree of heterosis.

The data shown in Table 2 is a summary of the greenhouse and field studies for the estimates general and specific combining ability. General combining ability was significant at all locations. Specific combining ability was significant in the greenhouse study and at one location only. These results suggest that the genetic variability in the populations was primarily of the additive type. The predominance of additive genetic variance combined with the significant heterosis on the negative side suggest that a breeder should utilize selection procedures that would increase gene frequencies of those genes with additive effect. With this approach, breeders could make considerable progress through selection of pure lines.

Summary

Field data on the response of Maryland tobacco varieties and hybrids to air pollution generally support that obtained in controlled greenhouse studies. From both greenhouse and field experiments, significant general combining ability estimates were reported which suggest that the genetic variability was primarily of the additive type. The significant heterotic response among hybrids suggest that hybridization should not be utilized for improvement of tolerance to air pollution. Selection in the development of pure lines would offer progress toward improvement of tolerance in Maryland varieties to air pollution.

Table 1. Mean weather fleck rating and heterotic response of Maryland tobacco varieties and hybrids to air pollution.

Entries	Field Results, 1972				Greenhouse Results, 1971	
	Location					
	Upper Marlboro	Davidson-ville	Dents-ville	Combined mean	Mean [b]	Range
Varieties [a]	29.49	23.58	28.15	27.08	5.9	3.1 (Wilson) ---------- 9.7 (Catterton)
Hybrids [a]	29.49	25.27	29.42	28.06	8.1	4.4 (Wil. x Md. 64) ---------- 15.9 (Md. 59 x Md. 609)
Heterosis (%)	0	7.17 **	4.51	3.62	37.3 **	

[a] Individual plants scored from 15 to 75.

[b] % area damaged per leaf.

** Significant at the 1% level of probability.

Table 2. General combining ability (GCA) and specific combining ability (SCA) mean squares for field and greenhouse studies involving air pollution effects on Maryland tobacco varieties and hybrids.

Source	Field Locations, 1972				Greenhouse Study, 1971	
	D. F.	Upper Marlboro	Davidson-ville	Dents-ville	D. F.	Mean Square
Hybrids	27	72.7 **	21.5 **	24.8 *	20	20.3 **
GCA	7	212.0 **	59.7 **	46.1 *	6	59.4 **
SCA	20	24.0 *	8.2	17.3	14	3.6 *

* and ** Significant at the 5% and 1% levels, respectively.

Glyphosate (Round-up) for Johnsongrass Control

J. V. Parochetti
Department of Agronomy

Purpose and Objectives

Johnsongrass is a serious weed problem in many fields in Maryland. At present, dalapon is used as a preplant foliar applied herbicide for johnsongrass control. Control from one application of dalapon has been approximately 50 to 80%. A new herbicide called glyphosate (formerly coded MON 2139) shows promise as a foliar applied herbicide for johnsongrass control. The object of this experiment is to compare glyphosate and dalapon as foliar treatments for johnsongrass control. Three experiments were conducted at three locations. The experimental design for all locations was a randomized complete block with 2 to 4 replications. Herbicides were applied with an experimental bicycle sprayer delivering 30 gallons per acre at 3 miles per hour. Visual ratings of johnsongrass top kill and rhizome kill were made by estimating percentage kill on a scale of 0 to 100 with 0 equalling no control and 100 equalling 100% kill.

Procedure

Experiment 1 was located at the Poplar Hill Research Farm near Salisbury. The soil type was an Evesboro loamy sand. Johnsongrass was 18 to 24 inches tall when dalapon or glyphosate was applied on June 10, 1971. Trifluralin, 0.5 lb/A, was preplant incorporated on June 23, 1971, and 'York' soybeans were planted on the same day. Plot size was 10 by 20 foot with two replications. All treatments were cultivated once approximately 5 weeks after planting.

The treatments are listed in Table 1. They included two rates of glyphosate and one rate of dalapon. Some treatments were plowed within one half hour of foliar treatment while others were plowed 12 days following

foliar treatment. In 1972, similar treatments were applied to the same experimental site. Johnsongrass, 16 inches tall, was treated with glyphosate and dalapon on June 2, 1972. The experimental design was a randomized complete block with two replications and identical to the experimental design for 1971. This afforded an opportunity to evaluate repeated applications of the same herbicides.

Experiment II was located at Still Pond, Kent County, Maryland, on a silt loam soil. Johnsongrass, having regrown from a clipping in mid-summer, was treated on September 16, 1971, when it was 30 inches tall. Treatments are listed in Table 3.

The experimental design was a randomized complete block with three replications, plot size was 10 by 25 foot.

Experiment III was located in Mechanicsville, St. Mary's County, Maryland, on a sandy loam soil. Johnsongrass, having been clipped at mid-summer, was treated on September 2, 1971, when it was 18 inches tall. Experimental design was a randomized complete block with four replications. Plot size was 10 by 20 feet.

Results

Experiment I. Glyphosate (Round-up) at 1 and 2 lb/A and dalapon at 5 lb/A applied to johnsongrass foliage and plowed 12 days later affected greater than 90% johnsongrass control when visually rated in July and August, 1971; in contrast, when these same herbicide treatments were plowed within 0.5 hours following foliar treatment, johnsongrass was 50% or less (Table 1). At the end of the growing season, johnsongrass control based on fresh weight was best, 89%, for 2 lb/A glyphosate. Both rates of glyphosate were 95% or more effective for johnsongrass control following similar treatments in 1971 observed on June 19, 1972 (Table 2). However, on October 2, 1972 johnsongrass control based on fresh weight of

the control in the harvested treatments was 100% from the 2 lb/A rate of glyphosate. At 1 lb/A glyphosate was only 70 to 72% effective. Johnsongrass control resulting from 5 lb/A dalapon was 39.5% on October 2, 1972.

Experiment II. Johnsongrass top kill when observed on October 5, 1971 increased from 0.5 to 2.5 lb/A of glyphosate (Table 3). Dalapon at 5 lb/A caused 50% top kill. Rhizome kill was estimated on October 15 by digging selected areas; it was noted that 1 lb/A or greater of glyphosate affected greater than 50% rhizome kill which was similar to dalapon at 5 lb/A. When observed in the spring, plowing enhanced the kill of rhizomes for glyphosate at 0.5, 1.5, and 2.5 lb/A and for dalapon. When johnsongrass rhizomes were observed in March, glyphosate at 1.5 and 2.5 lb/A plus plowing effected 100% rhizome kill. Dalapon plus fall plowing effected 78% kill which was significantly better than dalapon without fall plowing which effected only 37% rhizome kill.

Experiment III. All rates of glyphosate resulted in significantly better johnsongrass rhizome kill than dalapon at 5 lb/A. Plowing alone caused a significant increase in rhizome johnsongrass control compared to the unplowed check. However, plowing 20 days after foliar treatment with dalapon or glyphosate did not enhance rhizome kill when observed on October 5, 1971.

When johnsongrass rhizomes were observed in March, 1972, both the non-plowed herbicide treatments and the plowed treatments affected greater than 93% johnsongrass kill and were not significantly different. However, dalapon plus fall plowing effected 86% rhizome kill when observed in March, 1972, compared to dalapon plus no-tillage which effected only 33% control.

Summary

Glyphosate (Round-up) is an extremely effective foliarly applied

herbicide for perennial johnsongrass control. Fall applications to actively growing johnsongrass were enhanced at one location with fall plowing; whereas, in another location, both fall plowed and non-plowed plots were equally effective in controlling johnsongrass.

Glyphosate at 1.5 lb/A appears to be the rate at which johnsongrass is effectively killed. Glyphosate is more effective than dalapon for johnsongrass control. Glyphosate can substitute for dalapon as a preplow foliar treatment prior to soybean planting. There appears to be an interval of time following glyphosate treatment necessary for translocation of glyphosate throughout the plant. The glyphosate was plowed a half hour after application, the herbicide treatments were virtually nullified. When glyphosate remains on the plant for 12 days before plowing, greater than 90% johnsongrass control resulted with 1 lb/A of glyphosate.

Table 1. A field study of glyphosate (Round-up) and dalapon (Dowpon) applied preplow to foliage of johnsongrass at the Poplar Hill Research Farm, 1971.

	Treatment 6/10/71	Rate lb/A	Time Plowed After Treatment	% Control (top growth) Visual Ratings 7/16/71	8/20/71	Based on Fresh Weight 9/9/71
1.	Control	----	0.5 hr	0 c	0 d	0 [a/] c
2.	Glyphosate	1.0	0.5 hr	15 bc	0 d	29 bc
3.	Glyphosate	2.0	0.5 hr	50 b	50 c	34 b
4.	Control	----	12 da	0 c	0 d	0 bc
5.	Glyphosate	1.0	12 da	90 a	90 b	67 a
6.	Glyphosate	2.0	12 da	95 a	98 a	89 a
7.	Dalapon	5.0	12 da	93 a	90 b	71 a

a/ Fresh weight of johnsongrass top growth from the control plot was 3202 lb/A.

Table 2. A field study of glyphosate and dalapon applied a second year following foli

Table 2. A field study of glyphosate and dalapon applied a second year following foliar treatments of johnsongrass at Poplar Hill Research Farm, 1972.

	Treatment	Rate lb/A	Johnsongrass Kill 6/19	Johnsongrass Ground Cover 8/8	Johnsongrass Kill 10/2 [a/]	Notes on the Previous Treatments in 1971
1.	Control	----	20 a	90.0 c	0 a	Trifluralin only at 1 lb/A.
2.	Glyphosate	1.0	95 bc	22.5 bc	72 bc	Trifluralin (1 lb/A) + glyphosate to foliage and plowed within one hour resulting in 29 to 34% control in August, 1971. Trifluralin only at 1 lb/A.
3.	Glyphosate	2.0	95 bc	2.5 a	100 c	
4.	Dalapon	5.0	30 a	60.0 bc	0 a	
5.	Glyphosate	1.0	97 c	47.5 bc	70 bc	Trifluralin (1 lb/A) + glyphosate or dalapon applied to foliage and plowed in 12 days resulting in 67 to 89% johnsongrass control in August, 1971.
6.	Glyphosate	2.0	100 c	0.0 a	100 c	
7.	Dalapon	5.0	47.5 ab	45.0 bc	39.5 ab	

[a/] Based on harvested fresh weight of control into fresh weight of treatment; fresh weight of johnsongrass in the control was 20,800 lb/A.

Table 3. A field study with glyphosate in Kent County, September 16, 1971.

Treatment[a/] 9/16/71	Rate lb/A	% Top Kill 10/5/71	% Rhizome Kill 10/5/71	% Rhizome Kill 3/28/72
1. Control	----	3.3 a	26.7 a	17 a
2. Glyphosate	.5	66.7 c	45.0 ab	47 bc
3. Glyphosate	1.0	76.7 cd	65.0 bcd	80 cd
4. Glyphosate	1.5	86.7 de	51.7 bcd	80 de
5. Glyphosate	2.0	94.3 e	65.0 bcd	80 de
6. Glyphosate	2.5	98.7 e	63.3 bcd	83 d
7. Dalapon	5.0	50.0 b	46.7 abc	37 b
8. Control	----	----	46.7 abc	77 cd
9. Glyphosate	.5	----	50.0 bcd	82 de
10. Glyphosate	1.0	----	70.0 cd	90 de
11. Glyphosate	1.5	----	48.3 a-d	100 f
12. Glyphosate	2.0	----	71.7 d	97 de
13. Glyphosate	2.5	----	70.0 cd	100 f
14. Dalapon	5.0	----	53.3 bcd	78 cd

[a/] Johnsongrass was about 30 inches tall. Treatments 8 to 14 were plowed September 30, 1971.

Table 4. A field study with MON 0468 in St. Mary's County, Maryland. Treatments established on September 2, 1971.

	Treatment[a/] 9/2/71	Rate lb/A	% Necrosis 10/5/71	% Rhizome Kill 10/5/71	3/28/72
1.	Control	----	5 a	8 a	0 a
2.	Glyphosate	1.5	96 c	73 d	95 de
3.	Glyphosate	2.0	97 c	85 d	93 cd
4.	Glyphosate	2.5	97 c	86 d	95 de
5.	Dalapon	5.0	72 b	53 c	33 a
6.	Control	----	----	33 b	75 b
7.	Glyphosate	1.5	----	85 d	98 de
8.	Glyphosate	2.0	----	90 d	99 de
9.	Glyphosate	2.5	----	86 d	100 e
10.	Dalapon	5.0	----	54 c	86 bc

a/ Johnsongrass about 18 inches tall. Treatments 6 to 10 were plowed September 14, 1971.

Herbicide Combinations for Soybean Weed Control

J. V. Parochetti
Department of Agronomy

Purpose and Objectives

There are a number of herbicides which are experimentally registered in soybeans for weed control. All of these herbicides control a certain group of weeds but fail to control other weeds. The purpose of these studies were to evaluate several experimental and registered herbicides alone and in combination to effect a greater spectrum of weed control in soybeans.

Procedure

Four field experiments were conducted for 1971. The experiments were located at the Poplar Hill Research Farm, near Salisbury, and the Wye Institute, near Queenstown.

Experiment I. The experiments located at the Poplar Hill Research Farm were on a Bertie silt loam. 'Kent' soybeans were planted May 25, 1972. Preemergence herbicides were applied May 26, 1972. Herbicides applied at cracking were applied June 2 and herbicides applied at the cotyledonary to first leaf stage were applied June 9. The experimental design was a randomized complete block with four replications and the plots were 15 by 20 foot with row spacing being 30 inches. Herbicides were applied with a bicycle sprayer at 20 gallons per acre.

Experiment II. An experiment was located at the Wye Institute on a Mattapex silt loam. Cutler soybeans were planted May 23, 1972. Preemergence herbicides were applied May 24, 1972. The experimental design was a randomized complete block with four replications and the

plot size was 10 by 20 feet with row spacings being 30 inches. Herbicides were applied with a CO_2 bicycle sprayer at 30 gallons per acre.

Experiment III. Experiment III was located at the Wye Institute on a Mattapex silt loam. Cutler soybeans were planted May 24, 1972. Preplant incorporated herbicides were applied May 23, 1972, and were incorporated with a tractor mounted rototiller tilling 3 to 4 inches deep. Preemergence herbicides were applied May 24, 1972. The experimental design was a randomized complete block with four replications and the plot size was 10 by 20 feet with 30 inch row spacings. Herbicides were applied with a CO_2 bicycle sprayer delivering 30 gallons per acre.

Table 1. European System for Evaluating Weed Response Utilized In These Investigations.

Rating Number	Effect on Crop	% Crop Injury	% Weed Control	Remarks
1	No Injury	0	100.0	Completely destroyed
2	May be injured	2.5	97.5	Very good control
3	A little injured	5.0	95.0	Good control
4	Injured, but satisfactory	10.0	90.0	Satisfactory
5	Injured, barely satisfactory	15.0	85.0	Just satisfactory
6	Not satisfactory	25.0	75.0	Unsatisfactory
7	Bad injury	32.5	65.0	Poor
8	Very bad injury	65.0	32.5	Very poor
9	100% destroyed	100	0	As untreated

Weed control and crop injury was rated on a scale of 1 to 9. This scale is known as the European system and corresponding percentages in weed or crop injury are given in Table 1.

Experiment IV. Experiment IV was located at the Wye Institute on a Mattapex silt loam. Cutler soybeans were planted May 24, 1972. Preplant incorporated and preemergence herbicides were applied May 23; incorporation was done with a tractor mounted rototiller tilling 3 to 4 inches deep. The experimental design was a randomized complete block with four

replications and the plot size was 10 by 20 feet with 30 inch row spacing. Herbicides were applied with a CO_2 bicycle sprayer delivering 30 gallons per acre.

Results

Experiment I. Greatest soybean injury occurred with the following herbicides applied to soybeans in the cotyledonary to first true leaf: alachlor + dinoseb and fluorodifen (Table 2). Chloramben + dinoseb at 1.5 + 3.0 lb/A was more effective at cracking than at preemergence applications. Lowering the rate of chloramben to .75 + 1.5 lb/A at cracking resulted in poor foxtail control. Combinations of alachlor + dinoseb, whether applied preemergence, at cracking, or cotyledonary to first leaf, were very effective on foxtail and fall panicum.

Chloramben, formulated at 6 lb/gal, was as effective as chloramben formulated at 2 lb/gal (treatment 12 vs. treatment 13, respectively). Dinoseb was not effective for annual grass control. Alachlor applied alone was effective for grassy weed control at all stages of application, whereas, fluorodifen was effective as a grassy weed control herbicide at preemergence and cotyledonary to first true leaf applications. The at cracking applications of fluorodifen were not effective on grassy weeds.

The only treatment that significantly reduced yields was the alachlor + dinoseb, 1.5 + 1.5 lb/A, applied as cotyledonary to first true leaf.

Experiment II. The herbicide that caused the most soybean injury whether alone or in combination was cyanazine (Bladex) (Table 3). Metribuzin (Sencor) at 0.5 lb/A also caused soybean injury but not to the extent of cyanazine. All herbicides were very effective on giant green foxtail, the dominant weed species in the test. With varying degrees of susceptibility, soybean yields corresponded closely with herbicides that caused less injury and the best weed control.

Experiment III. Giant green foxtail was controlled by a number of herbicides with the exception of low rates of metribuzin and chloramben in combination with metribuzin (Table 4). Redroot pigweed control was generally excellent with all herbicides except trifluralin. Poor yellow nutsedge control resulted in most treatments and variable weed control of morningglory was experienced. Most of the herbicides did not cause any soybean stand or vigor reduction except metribuzin at 1 lb/A which caused severe vigor and stand reduction.

Experiment IV. The AC coded compound affected vigor of soybeans more than stand reduction at the higher rates of the herbicides studied. When the herbicides were incorporated, soybean vigor reduction was always greater than the preemergence applications at the high rate. Giant green foxtail was controlled very effectively by all herbicides. Morningglory, nutsedge and jimsonweed control was variable.

Summary

Eleven coded or non registered herbicides and nine registered herbicides were evaluated for weed control in soybeans and their effect on soybean yield. Fluorodifen and dinoseb applied to soybeans at cracking or in the trifoliate injured soybeans but generally did reduce yields except dinoseb applied in the trifoliate stage. Most herbicides or combination affected good to excellent weed control with little soybean injury. Cyanazine (SD 15418) and Metribuzin (BAY 94337 tradenamed Sencor or Lexone) injured soybeans.

Table 2. The Effect of Preemergence Herbicides Applied at Different Soybean Growth Stages, Poplar Hill Research Farm, 1972.

	Treatments[a/]	Rate lb/A	Time of Application	Soybean Kill 6/19	Soybean Defoliation 6/19	Soybean Injury 6/19	Foxtail 6/19	Fall Panicum 6/19	Soybean Yields
1.	Control	----	----	1.0	1.0	1.0	9.0	9.0	27.56
2.	Control Cult.	----	----	1.0	1.0	1.0	8.75	7.5	26.88
3.	Chloramben (Amiben)	1.5	pre	1.0	1.0	1.0	4.5	3.5	26.09
	+ Dinoseb (Premerge)	3.0	pre						
4.	Chloramben	1.5	at cracking	1.5	1.0	1.5	2.0	2.0	28.47
	+Dinoseb	3.0	at cracking						
5.	Chloramben	0.75	at cracking	1.0	1.0	1.0	5.0	3.5	30.85
	+ Dinoseb	1.5	at cracking						
6.	Alachlor (Lasso)	1.0	pre	1.0	1.0	2.25	1.5	1.5	31.76
	+ Dinoseb								
7.	Alachlor	1.5	pre	1.0	1.0	3.25	1.5	1.75	34.25
	+ Dinoseb	1.5	pre						
8.	Alachlor	1.0	at cracking	1.0	1.0	2.0	1.75	1.75	32.10
	+ Dinoseb	1.5	at cracking						
9.	Alachlor	1.5	at cracking	1.0	1.0	4.25	1.75	1.5	32.67
	+ Dinoseb	1.5	at cracking						
10.	Alachlor	1.0	cotyl lst leaf	5.25	7.5	7.5	2.0	1.75	24.50
	+ Dinoseb	1.5	cotyl lst leaf						
11.	Alachlor	1.5	cotyl lst leaf	5.0	8.0	7.75	1.25	1.0	19.17
	+ Dinoseb	1.5	cotyl lst leaf						
12.	Chloramben (Amiben) (6 lb/gal formul.)	3.0	pre	1.0	1.0	1.25	3.0	2.75	30.85
13.	Chloramben	3.0	pre	1.0	1.0	1.0	2.75	1.5	30.06
14.	Chloramben	1.5	pre	1.0	1.0	1.0	4.0	4.0	32.32
15.	Chloramben	1.5	at cracking	1.0	1.0	1.25	3.5	2.75	28.92
16.	Dinoseb	3.0	pre	1.0	1.0	1.0	3.25	1.0	27.33
17.	Dinoseb	3.0	at cracking	1.0	1.0	1.0	8.25	8.0	25.63
18.	Dinoseb	1.5	pre	1.0	1.0	1.25	6.5	4.0	26.43
19.	Dinoseb	1.5	at cracking	1.0	1.0	1.0	5.5	3.75	26.99
20.	Alachlor	2.0	pre	1.0	1.0	3.0	1.0	1.0	35.05
21.	Alachlor	1.0	pre	1.0	1.0	1.50	1.0	1.75	26.88
22.	Alachlor	1.5	pre	1.0	1.0	2.25	1.0	1.25	32.21
23.	Alachlor	1.0	at cracking	1.0	1.0	3.5	2.0	1.25	34.14
24.	Alachlor	1.5	at cracking	1.0	1.0	2.5	2.5	2.0	33.91
25.	Alachlor	1.0	cotyl lst leaf	1.0	1.25	5.5	2.75	2.25	30.17
26.	Alachlor	1.5	cotyl lst leaf	1.25	1.25	5.5	3.75	2.25	31.08
27.	Fluorodifen (Preforan)	3.0	pre	1.0	1.0	2.75	1.0	1.0	34.48

Table 2. (contd.)

Table 2. (contd.)

	Treatments[a/]	Rate lb/A	Time of Application	Soybean Kill 6/19	Soybean Defoliation 6/19	Soybean Injury 6/19	Foxtail 6/19	Fall Panicum 6/19	Soybean Yields
28.	Fluorodifen	3.0	at cracking	1.0	1.0	1.25	6.0	4.25	29.04
29.	Fluorodifen	3.0	cotyl 1st leaf	3.25	6.25	7.0	1.0	1.0	29.94
			lsd 0.05 =	.58	.33	.98	1.61	1.91	6.90
			lsd 0.01 =	.77	.44	1.30	2.14	2.54	9.17

[a/] All chloramben formulations used were 2 lb/A gal except where noted.

Table 3. The Effect of Several Preemergence Experimental Herbicides on Soybeans and Annual Weed Control.

	Treatment	Rate lb/A	Soybean Vigor	Soybean Stand	Giant Green Foxtail	Soybean Yield Bu/A
			July 2, 1972			
1.	Control	----	1.0	1.0	9.0	23.61
2.	Control, Cultivated	----	1.0	1.0	9.0	34.34
3.	Prynachlor (Basamaize) + Linuron (Lorox)	3.0 + 0.5	1.75	1.25	1.5	37.66
4.	Prynachlor + Chlorbromuron (Maloran)	1.5 + 1.0	2.50	1.5	2.5	27.88
5.	Alachlor (Lasso) + Chlorbromuron	1.5 + 1.0	1.25	1.0	1.0	35.27
6.	Linuron + Alachlor	0.5 + 1.0	1.0	1.0	1.5	40.58
7.	Linuron + Alachlor	0.5 + 1.5	2.0	2.0	1.5	34.53
8.	Prynachlor	3.0 +	1.25	1.25	2.0	36.50
9.	Linuron	0.5	1.0	1.0	3.5	31.37
10.	Chlorbromuron	1.0	1.5	1.0	3.5	28.90
11.	Alachlor	1.0	1.0	1.0	2.0	33.28
12.	Alachlor	1.5	1.0	1.0	1.25	30.99
13.	Chlorbromuron + Fluorodifen (Preforan)	1.0 + 2.0	1.0	1.0	3.0	37.11
14.	Fluorodifen	2.0	1.0	1.0	2.75	37.32
15.	SD 15418 (Bladex)	1.0	3.75	3.75	2.25	29.94
16.	SD 15418	1.5	4.5	5.75	1.0	28.74
17.	Alachlor 10G	1.5	1.5	1.25	2.5	33.25
18.	Alachlor + BAY 94337 (Sencor)	1.5 + 0.5	3.75	2.75	1.0	25.09
19.	Alachlor + SD 15418 (Bladex)	1.0 + 1.0	4.0	2.5	1.25	32.28
20.	Alachlor + SD 15418	1.5 + 1.5	5.0	6.0	1.0	22.75
		lsd 0.05 =	1.11	1.36	1.08	10.21
		lsd 0.01 =	1.47	1.81	1.44	13.59

Table 4. The Effect of Several Preplant Incorporated or Preemergence Herbicides for Annual Weed Control

Table 4. The Effect of Several Preplant Incorporated or Preemergence Herbicides for Annual Weed Control in Soybeans.

	Treatment	Rate lb/A	Time of Application	7/7/72 Soybeans Vigor	Soybeans Stand	Giant Foxtail	Green Morningglory	Yellow Nutsedge	Redroot Pigweed	Soybean Yields Bu/A 11/4
1.	Control	----	----	1.0	1.0	9.0	9.0	9.0	9.0	27.79
2.	Control Cultivated	----	----	1.0	1.0	9.0	9.0	9.0	9.0	38.84
3.	EL 119 (Ryzelan)	1.5	pre	1.75	1.0	3.0	3.0	8.25	1.0	38.22
4.	EL 119	3.0	pre	1.25	1.0	2.25	1.75	7.0	1.0	42.28
5.	EL 119 + BAY 94337 (Sencor)	1.5 + 0.3	pre	1.25	1.0	1.25	2.0	7.25	1.0	41.17
6.	EL 119 + BAY 94337	1.5 + 0.4	pre	1.75	1.0	2.25	4.25	5.75	1.0	35.52
7.	Control	1.0	ppi	1.0	1.0	7.75	6.75	7.5	7.0	32.67
8.	BAY 94337	0.3	pre	1.0	1.0	8.25	3.5	6.5	1.0	40.56
9.	BAY 94337	0.4	pre	1.5	1.0	5.25	5.0	7.0	1.5	43.10
10.	BAY 94337	0.5	pre	3.5	1.75	2.75	4.5	4.25	1.0	41.40
11.	BAY 94337	1.0	pre	7.0	5.75	1.75	3.25	3.0	1.0	24.72
12.	A-820	1.5	ppi	2.25	1.0	2.50	2.50	6.75	1.0	38.84
13.	A-820	3.0	ppi	3.0	1.0	2.5	1.50	6.25	1.0	39.63
14.	CGA 10832	0.75	ppi	1.25	1.0	1.75	4.0	7.75	1.0	39.11
15.	CGA 10832	1.5	ppi	2.25	1.25	1.25	1.75	6.75	1.0	35.09
16.	CGA 10832 + Fluorodifen (Preforan)	0.75 + 3.0	ppi pre	1.75	1.0	1.0	2.0	5.75	1.0	37.09
17.	Fluorodifen	3.0	pre	1.5	1.0	1.75	2.5	6.25	1.0	34.14
18.	Chloramben (Amiben) + BAY 94337	1.5 + 0.3	pre pre	2.25	1.0	5.25	4.25	6.75	1.0	33.19
19.	Chloramben + BAY 94337	1.5 + 0.4	pre pre	1.5	1.0	4.25	3.25	6.75	1.0	39.93
20.	A-820 + BAY 94337	1.5 + 0.3	ppi pre	1.25	1.0	2.5	2.5	6.75	1.0	39.09
21.	A-820 + BAY 94337	1.5 + 0.4	ppi pre	1.5	1.0	2.75	2.5	5.25	1.0	37.09
22.	Chloramben (Amiben)	1.5	pre	1.0	1.0	8.0	6.5	7.0	3.0	35.73
			lsd 0.05 =	1.36	.49	1.83	2.65	2.48	1.7	7.0
			lsd 0.01 =	1.81	.65	2.44	3.51	3.29	2.26	9.31

Table 5. The Effect of Several Experimental Substituted Dinitroaniline Herbicides on Soybeans and Annual Weeds.

	Treatment	Rate lb/A	Time of Application	July 2, 1972 Vigor	Stand	Foxtail	Morningglory	Nutsedge	Jimsonweed	Soybean Yields Bu/A
1.	Control	----	----	1.0	1.0	9.0	9.0	9.0	7.25	29.67
2.	Control Cultivated	----	----	1.25	1.0	9.0	8.75	9.0	8.0	34.84
3.	AC 92553	1.0	pre	1.50	1.0	2.25	6.75	6.5	2.75	34.03
4.	AC 92553	2.0	pre	1.0	1.0	1.75	3.25	5.5	3.0	30.96
5.	AC 92553	1.0	ppi	2.0	1.0	1.50	3.0	4.5	3.25	37.13
6.	AC 92553	2.0	ppi	4.25	1.75	1.75	1.0	4.25	1.25	27.45
7.	AC 92594	1.0	pre	2.0	1.25	2.5	3.75	4.75	3.0	37.45
8.	AC 92594	2.0	pre	1.25	1.0	2.0	2.50	2.75	2.75	28.40
9.	AC 92594	1.0	ppi	2.75	1.25	2.75	1.50	4.5	3.0	35.02
10.	AC 92594	2.0	ppi	4.75	2.0	1.75	2.25	5.0	1.25	31.35
11.	AC 92826	1.0	pre	1.5	1.0	3.25	4.0	5.75	1.75	36.50
12.	AC 92826	2.0	pre	3.0	1.75	2.5	2.25	5.0	3.50	33.50
13.	AC 92826	1.0	ppi	1.5	1.0	3.75	4.75	4.75	2.50	33.16
14.	AC 92826	2.0	ppi	3.5	1.75	2.0	2.50	5.25	2.50	32.57
15.	AC 92390	1.5	pre	2.0	1.0	2.75	5.0	4.25	1.25	33.94
16.	AC 92390	3.0	pre	2.0	1.0	2.25	4.25	4.25	1.75	37.75
17.	AC 92390	1.5	ppi	1.75	1.0	3.50	3.0	3.75	3.0	30.06
18.	AC 92390	3.0	ppi	4.0	1.5	1.50	2.25	3.50	3.0	34.12
19.	Alachlor (Lasso)	1.5	pre	1.75	1.0	1.25	4.75	3.50	1.0	33.21
20.	Trifluralin (Treflan)	0.75	ppi	4.0	1.75	1.50	1.75	3.25	2.75	35.52
			lsd 0.05 =	1.66	.72	1.66	2.38	2.46	2.72	8.13
			lsd 0.01 =	2.22	.96	2.20	3.19	3.27	3.62	10.82

Evaluation of Winter Malting Barley in Maryland

J.G. Shannon
Department of Agronomy

Purpose and Objectives

The humid environment is considered a limiting factor in production of high quality malting barley in Maryland. Also, yield of the current winter variety being grown for malt in Maryland has not been as high as feed types adapted to the state. Malting barley varieties with improved yield would make malting barley culture more economical as well as giving farmers more incentive to produce it.

Procedure

Strains of winter barley with malting potential obtained from Michigan and New York were evaluated for the second year under Maryland conditions. They were grown at the University of Maryland Forage Research Farm near Clarksville, Maryland. Comparisons among these strains with the varieties Tschermak, a winter two-rowed malting variety, and Barsoy a popular six-rowed feed barley were made for malting quality and yield.

Results

Yield and bushel weight for several barley strains with malting potential, as compared to Tschermak and Barsoy are presented in Table 1. Tschermak was the highest yielding variety in the test at 76.8 bushels per acre. Previous data has shown Tschermak to be lower in yield potential than six-rowed barley strains. The highest yielding six-rowed malting strain was NY6005-18 at 74.9 bushels as compared to 63.2 bushels for Barsoy. Several other six-rowed strains approached or surpassed Barsoy for yield. None of the two-rowed strains approached Tschermak in yield.

Malting quality data for the strains are presented in Table 2. A

popular spring malting variety, Larker, was added as a check, but was not grown under Maryland conditions.

Kernel plumpness percentages of six-rowed varieties were low to intermediate except for Malta. The two-rowed strains were plumper than the six-rowed strains. Barley nitrogen percentages were low. Agtron hull scores for brightness were extremely low for Maryland grown strains compared to Larker grown in the Midwest. The low scores were due to the extremely poor conditions prior to harvest resulting in dark, weathered kernels.

Diastatic power, a measure of enzymatic potential for converting starch to malt was highest for MSU 420-11 and lowest in Carstens. MSU 420-11 was the two-rowed strain rated best for malting quality; however, Tschermak and Carstens were much better in kernel plumpness.

Summary

Several winter barley strains with malting potential were evaluated at the University of Maryland Forage Research Farm near Clarksville, Maryland. These strains were compared to Tschermak, the current malting variety and Barsoy, a popular feed variety for yield and malting quality.

Tschermak was the highest yielding of the two-rowed strains, but was not as good as MSU 420-11 for malting quality. NY6005-18 was the highest yielding six-rowed malting strain in comparison to Barsoy.

Table 1 - Yield and test weight of several malting barley strains grown at Clarksville, Maryland, 1972

Strain		Yield (Bu/A)	Rank	Bushel weight lbs.
Barsoy	(6)*	63.2	6	48
Tschermak	(2)	76.8	1	49
MSU 420-11	(2)	40.7	11	47
MSU 447-18	(2)	65.2	4	50
MSU 448-19	(6)	62.7	7	46
MSU 448-24	(6)	67.2	3	47
NY6005-15	(6)	63.4	5	49
NY6005-18	(6)	74.9	2	46
NY6005-19	(6)	55.0	9	46
Cass	(6)	55.8	8	50
Carstens	(2)	47.0	10	47
Malta	(2)	37.3	12	48

*Number in parenthesis indicates two-rowed or six-rowed.

Table 2. Evaluation of barley and malt quality for several strains, Clarksville, Maryland, 1972.

Winter Malting Barley Grown At Clarksville, Maryland	BARLEY			MALT EXTRACT (% dry basis)		WORT		NITROGEN (% dry)			Dia-static Power (Deg)	AMYLASE	
	Kernel Weight (mg)	Plump-ness (%)	Color Score (Agtron)	Fine Grind	Coarse Grind	Color	Clarity	Barley	Malt	Wort		Maltase Equiv	20° Unit
MSU-420-11	28.7	38.3	22	78.9	78.2	1.7	Sl**hazy	1.46	1.43	.567	154	507	32.8
MSU-447-18	31.9	54.6	28	78.6	76.9	2.0	Sl. hazy	1.54	1.55	.567	150	509	28.6
MSU-448-19	30.0	31.2	20	76.9	74.8	2.0	Sl. hazy	1.53	1.57	.569	151	503	30.8
MSU-448-24	28.7	47.0	24	78.4	77.5	2.0	Sl. hazy	1.45	1.48	.576	149	482	34.4
Cass	31.3	56.0	28	79.0	77.5	1.9	Sl. hazy	1.55	1.61	.625	151	484	36.5
Malta	36.3	83.0	16	79.1	77.7	1.9	Sl. hazy	1.65	1.64	.615	121	351	39.3
NY-6005-15	24.7	31.6	26	77.4	74.8	1.7	hazy	1.59	1.55	.571	139	459	30.0
NY-6005-18	27.5	33.0	20	77.4	75.5	1.9	hazy	1.45	1.41	.553	140	451	32.9
NY-6005-19	27.1	46.3	24	78.7	77.3	1.9	hazy	1.54	1.49	.616	142	457	33.4
Tschermak	30.6	63.2	24	79.3	77.7	2.0	hazy	1.61	1.65	.564	131	437	27.6
Carstens	29.8	70.4	16	77.8	75.9	1.9	Sl. hazy	1.77	1.79	.705	119	361	34.5
Barsoy	24.0	56.2	22	77.8	76.2	1.9	Sl. hazy	1.66	1.71	.719	130	387	39.1
Larker*	35.5	95.5	54	78.9	77.9	1.5	hazy	2.03	2.01	.700	217	765	31.4

*Sample of Larker provided by Barley and Malt Laboratory; not grown in Maryland.
**Sl. indicates Slightly.

Ozone Damage to Wheat Varieties at Anthesis

J.G. Shannon and C.L. Mulchi
Department of Agronomy

Purpose and Objectives

The air pollutant ozone has been shown to cause extensive injury to crops along the east coast. Ozone concentrations high enough to injure sensitive plant species have been observed more than 70 miles from densely populated areas where peak concentrations occur.

Wheat is a crop which is relatively sensitive to ozone. The effects of ozone on two wheat varieties during anthesis and subsequent effects on yields, yield characteristics and seed set were examined. Such information is needed to improve tolerance of wheat varieties to ozone toxicity.

Procedure

Two soft red winter wheat varieties, Arthur '71 and Blueboy were planted in four inch pots in the greenhouse. After being vernalized plants were maintained at greenhouse temperatures of 70°F during the day and 60°F at night. Supplemental incandescent light was supplied to impose a long day to induce flowering.

At Anthesis, 60 pots of each variety were divided at random into three groups of 20 pots. Each group of plants for both varieties was exposed to one of three treatments as follows:

1. Exposure to 0.2 ppm of ozone in the growth chamber for four hours per day for seven days;
2. Control - growth chamber
3. Control - greenhouse

Growth chambers were maintained under a 14 hour day and at the same day night temperature as mentioned for the greenhuuse. Treatment with ozone was carried out for seven days in order that heads from late tillers might be exposed during anthesis. After the seven day treatment, plants were returned to the greenhouse until ripe.

*Sample of Larker provided by Barley and Malt Laboratory; not grown in Maryland.
**SL- indicates Slightly-

Characteristics measured at maturity within each treatment on a per plant basis were: grain yield, number of seeds, seed per head, average kernel weight and percent seed set. Analyses of variance were computed for a completely random design with three treatments and twenty observations per treatment.

Results

The effects of ozone treatment on Arthur '71 and Blueboy wheat varieties for several characteristics are shown in Table 1. In general, the greenhouse control and the growth chamber control treatments were similar for all the attributes studied. The ozone treatment lowered grain yields by 29.9 and 23.9 percent for Arthur '71 and Blueboy, respectively. Although the reduction in yield was significant only for Arthur '71, the trend for reduction in yield for Blueboy was evident. There were trends toward reductions in seeds per plant, seed per head, and kernel weight for the ozone treated plants as compared to the growth chamber control plants, although the differences were not significant. Percent seed set was also lower in plants treated with ozone, with a significant reduction of 22.1% in Blueboy.

Both varieties were not affected to the same degree by ozone treatments for the various characteristics studied. This was especially evident for kernel weight and percent seed set. Blueboy was affected to a greater degree for reduction in seed set than Arthur '71. However, kernel weight was significantly reduced in Arthur '71 and only slightly in Blueboy.

Summary

Two wheat varieties Arthur '71 and Blueboy were exposed to 0.2 ppm ozone at anthesis. Yields were reduced about 30 and 23 percent for Arthur '71 and Blueboy, respectively. Reductions in yield due to ozone could be attributed to a reduction in seed per plant, seed per head, kernel weight and seed set.

Table 1. Mean comparisons of ozone treatment with controls for several characteristics in Arthur '71 and Blueboy wheat

Table 1. Mean comparisons of ozone treatment with controls for several characteristics in Arthur '71 and Blueboy wheat

Treatment	Yield grams/plant		Seed per plant		Seed per head		Kernel Weight, milligrams		Percent Seed set	
	Arthur '71	Blueboy	Arthur '71	Blueboy	Arthur '71	Blueboy	Arthur '71	Blueboy	Arthur '71	Blueboy
Greenhouse Control	19.4b*	16.1a	53.5a	49.9a	12.8a	19.2a	36.3b	31.6a	44.9a	54.4b
Growth Chamber Control	18.0b	18.6a	51.2a	59.1a	12.3a	18.7a	35.2a	32.0a	44.9a	49.4b
Ozone Treatment	12.6a	13.1a	43.2a	45.0a	11.5a	15.4a	29.0a	31.2a	41.1a	38.5a
Percent** Reduction	29.9	23.9	15.5	23.9	6.1	17.6	17.4	2.4	8.3	22.1

* Means based on the average of 20 plants. Those treatment means within the same column followed by the same letter are not significantly different at the .05 level based on Student-Newman-Kuel's test.

** Reduction of ozone treatment compared to growth chamber control.

Alfalfa Strain Tests for Yield and Anthracnose Resistance

J. A. Schillinger and T. E. Devine
Agronomy Department and Plant Science Division, U.S.D.A.

Purpose and Objectives

Alfalfa is known as the queen of the forages and rightfully so, since it provides an excellent feed for livestock. In Maryland, alfalfa production has been limited by anthracnose crown and stem rot. Resistance to anthracnose was found in 1969 by U.S.D.A. and University of Maryland scientists. Since then an extensive research program has been launched to select new alfalfa varieties with high levels of resistance to anthracnose as well as other serious disease and insect pests. One of the products of this cooperative research effort is the experimental strain, $MSHp6FAn_2W_2$.

The purpose of this study was to evaluate, under conditions of intensive management in the field, $MSHp6FAn_2W_2$ and other cultivars and experimental strains of alfalfa.

Procedures

Broadcast plots of fourteen alfalfa cultivars and experiment strains were seeded at the rate of 18#/acre on March 18, 1970. A randomized block design with four replications was used. The plots were 5' x 16' in size and the harvest strip included a 3' x 13' area. Prior to seeding, Dolomitic limestone at 1000#/acre and 500#/acre of 5-20-20 were applied and disked into the soil. In the spring of 1971 and 1972, 800 lbs of 0-15-30 with borax was applied to the plot area.

Four harvests were made in 1972 on June 2, July 7, August 21, and November 2. After green plot weight was recorded, a moisture sample was taken, weighed, dried at 105°F for three days, reweighed, and % dry matter calculated. Plot yields of alfalfa forage were converted to 12% moisture.

Results

Forage yields of the fourteen alfalfa cultivars and experimental strains are presented in Table 1. MSHp6FAn$_2$W$_2$ outyielded the standard cultivars, Saranac, Williamsburg, and Team. Hay yields of 7.36 tons per acre were obtained for MSHp6FAn$_2$W$_2$ and 6.36, 6.24, and 6.30 tons/acre for Saranac, Williamsburg, and Team, respectively, in the four harvests.

Stand cover for the MSHp6FAn$_2$W$_2$ plots was estimated at 38% in April 1972, whereas Saranac, Williamsburg, and Team were 10, 14, and 18% respectively. The added resistance to anthracnose in MSHp6FAn$_2$W$_2$, which is not present in the other cultivars, apparently has resulted in greater stand persistence.

Summary

1. Anthracnose crown and stem rot has been found to be a serious alfalfa disease in Maryland.
2. Percent stand cover as measured by plant numbers and stems per plant was more than doubled with anthracnose resistance.
3. Forage yields were increased by nearly 15% with anthracnose resistance.

Table 1. Forage yield (tons/acre), stand cover, and plant height of 14 alfalfa varieties and experimental strains. Wye Institute - 1972.

Entry	Forage Yield (tons/acre at 12% moisture)					Estimated % cover	Plant Ht. (cm)
	6-2	7-7	8-21	11-2	Total	4-21	10-27
Bonanza	1.52	1.37	2.24	.80	5.93	5	52
Cherokee	2.19	1.73	1.92	.88	6.72	26	47
DuPuits	1.96	1.94	1.74	.81	6.45	10	57
Florida 66	1.71	1.37	1.62	.82	5.52	7	56
Moapa	1.23	1.21	1.97	.71	5.12	4	49
Saranac	2.21	1.57	1.74	.84	6.36	10	44
Team	2.10	1.53	1.95	.72	6.30	14	38
Weevlchek	2.11	1.46	2.06	.84	6.47	12	39
Williamsburg	2.09	1.68	1.67	.80	6.24	18	50
MSA-CW3	2.39	1.42	1.89	.84	6.54	14	47
MSHp6FAn2W2	3.05	1.79	1.57	.95	7.36	38	47
MSHp6F-OV	2.25	1.59	1.97	.95	6.76	21	47
MSHpB3	2.31	1.54	1.58	.90	6.33	24	56
MSHp8	2.25	1.45	1.57	.82	6.09	19	50
Average	2.10	1.55	1.82	.83	6.30	15	49
"F" Entries	6.27**	3.84**	2.10*	1.53	.89	5.33**	2.20**
LSD (.05)	.24	.14	.41	-	-	11	11
LSD (.01)	.32	.19	-	-	-	15	-
CV (%)	16	12	16	14	10	51	15

Breeding Soybeans that Respond to Potassium Fertilization

J. A. Schillinger and A. K. Walker
Department of Agronomy

Purpose and Objectives

Soybeans have developed a reputation, and rightfully so, as a crop that will not respond to direct fertilization. From some of our earlier work, we found perhaps one explanation for this phenomenon. The old soybean variety, Lincoln, has been a consistent non-responder to K applications in our studies. Lincoln also is a very common ancestor of our popular modern soybean varieties. Thus, it appears that some of the poor response to fertilizer in soybeans may have been passed along to our new varieties by soybean breeders.

The objectives of this study were (1) to verify the earlier findings of differential K levels in the leaves of responding and non-responding genotypes during the life cycle, and (2) to study the influence of reciprocal grafting responding and non-responding roots and tops on respond patterns to K fertilizer.

Procedures

Selected responding (FC 31702) and non-responding (Lincoln) soybean genotypes were studied for growth, yield, and K uptake while growing under three levels of K fertilization in the field. The varieties Kim and Cutler were included for comparison. The three K levels were 0, 150, and 400 pounds of K_2O/acre applied and disked into the soil prior to planting. Each plot consisted of four rows 20' long; leaf samples and yield data were collected from three replications of each treatment. The experimental design was a split plot with potassium fertility as the whole plots and genotypes as the sub-plots.

Leaf samples were taken at biweekly intervals from the most recent expanded trifoliate leaflets. Sampling began two weeks after emergence and continued until leaf senescence. A mineral analysis of the leaf tissue was completed by the University of Maryland Plant Analysis Laboratory. Pod counts were taken prior to harvest from one 16' row per plot. The row was cut and threshed for yield determination on October 1. Yield samples were air dried, weighed, and converted to bushels per acre. Seed size samples were taken for each treatment by counting and weighing 500 seeds.

The following FC 31702 and Lincoln grafts were made in the greenhouse: FC 31702/FC 31702, FC 31702/Lincoln, Lincoln/FC 31702, and Lincoln/Lincoln. After the grafts were well knitted, they were transplanted as spaced plants into the field that had been treated with the three differential levels of K as described above. Leaf samples were taken four times from July 20 to September 17. Pod counts were taken before harvest. Yield data was derived from three grafts per plot and three replications.

Results

Analysis of variance of the leaf samples taken throughout the growing season shows genotypic differences from August 3 through September 15 (Table 1). Where potassium was applied, FC 31702 appeared to have a significantly greater intake of the cation into the plant than the non-responder Lincoln. Cutler also had a considerable higher uptake of K than did Kim or Lincoln. Prior to August 3, the percentage of K in the leaves was similar for all the varieties. Cutler appeared to translocate a higher percentage of K into the seed. Cutler and FC 31702 had a higher level of K during the flowering and pod filling stage which began just prior to the third leaf sampling.

From the data on pods per plant, seed per pod, and grams per 100 seed, FC 31702 and Lincoln responded the same, averaging the three soil treatments. Kim is a large seed variety with many single seed pods.

Yield data from 1972 showed differential responses for FC 31702 at each K fertility and the lack of response of Lincoln from the intermediate K level (K_1) to the high K level (K_3) (Table 2). FC 31702 had a 61.5% increase in yield for K_3 versus K_0. FC 31702 was comparable in yield to Cutler and Kim at the high fertility level and significantly greater than Lincoln at the K_3 level.

The yield data on the grafts did not show complete scion or root control of K responsiveness (Table 3). The grafts with potassium yielded significantly better than the K_0 grafts.

The pods per plant and seeds per pod were significantly different for like scion grafts (Table 4). The FC 31702/FC 31702 and FC 31702/Lincoln grafts had significantly more pods/plant but significantly less seeds/pod. Grams per 100 seed was similar for all the grafts.

Analysis of variance on the leaf sample and seed sample for %K showed significant differences between K levels at all dates and genotypic significance at the August 3 date. FC 31702/FC 31702 and FC 31702/Lincoln grafts had higher %K at August 3 for the K_1 and K_3 levels and lower %K at harvest in the seed.

Summary

The FC 31702 genotype has the ability to take up more potassium and shows increase response in yield with higher potassium fertility. Lincoln again failed to respond in yield at high fertility levels. The leaf analysis of %K has shown similar trends in past years of the responder FC 31702 and non-responder Lincoln.

The FC 31702 and Lincoln tops appeared to have control in producing pods per plant and seed per pod. All grafts showed increases in %K to higher K fertility.

Table 1. Percent potassium in soybean leaves at 6 sampling dates and in soybean seed at harvest of FC 31702, Cutler, Kim, and Lincoln. 1972.

Genotype	Potassium	%K in Leaves[1/]						%K in Seed[1/]
		7-6	7-20	8-3	8-17	8-31	9-15	10-13
FC 31702	K0	1.87	2.03	1.37	1.10	0.80	0.53	1.73
	K1	2.80	3.43	2.63	2.37	1.83	1.53	2.07
	K3	2.80	3.80	2.90	2.46	1.97	1.73	2.03
Cutler	K0	2.20	2.10	1.60	1.33	0.83	0.53	1.90
	K1	2.77	2.30	2.70	2.13	1.77	1.33	2.20
	K3	2.57	3.63	2.70	2.03	1.80	1.63	2.10
Kim	K0	2.07	1.87	1.30	0.87	0.57	0.40	1.60
	K1	2.47	3.23	2.43	1.87	1.37	0.67	2.03
	K3	2.87	3.30	2.50	1.80	1.50	1.17	2.03
Lincoln	K0	2.00	1.93	1.40	0.97	0.67	0.40	1.63
	K1	2.33	3.20	2.70	2.07	1.57	1.23	2.07
	K3	2.43	3.20	2.53	1.87	1.70	1.37	2.03
Potassium		**[2/]	**	**	**	**	**	**
Genotype				**	**	**	**	**
Geno. x Pot.[3/]								

1/ Figures are means of three replications.

2/ ** indicates significant differences at 1% level of probability according to analysis of variance.

3/ No treatment interactions were found at 5% probability level and 18 degrees of freedom.

Table 2. Response in Yield of FC 31702, Cutler, Kim, and Lincoln genotypes to potassium. 1972.

Genotype	Yield (Bu/A)[1/] K0	K1	K3	Mean
FC 31702	19.5 f[2/]	24.0 d	31.7 ab	25.07 b
Cutler	27.0 c	31.1 b	32.9 a	30.33 a
Kim	25.5 cd	31.5 ab	32.4 ab	29.80 a
Lincoln	22.2 e	26.4 c	26.3 c	24.97 c
Mean 23.	23.55 b	28.25 ab	30.82 a	
C.V. (%) = 13.5				

1/ K0 = no potash added; Soil Test = 79L
K1 = 150 lbs/A potash added; Soil Test = 155M
K3 = 400 lbs/A potash added; Soil Test = 231H

2/ Figures followed by same letter are not significantly different at the 5% probability level according to Duncan's Multiple Range Test.

Table 3. Response in yield of FC 31702/FC 31702, FC 31702/Lincoln, Lincoln/FC 31702, and Lincoln/Lincoln grafts. 1972.

Graft	Yield (grams/plant)[1/] K0	K1	K3	Mean
FC/FC	49.3 h[2/]	96.2 a	88.2 ab	77.90 a
FC/L	56.9 efgh	74.4 bcdef	75.6 bcde	68.97 ab
L/FC	51.8 gh	64.3 cdefgh	70.2 bcdefg	62.10 b
L/L	52.7 fgh	58.2 defgh	78.1 bcd	63.00 b
Mean	52.68 b	73.28 a	78.02 a	
C.V.(%) 'a' = 18.4				
'b' = 15.4				

1/ K0 = no potash added; Soil Test = 79L
K1 = 150 lbs/A potash added; Soil Test = 155M
K3 = 400 lbs/A potash added; Soil Test = 231H

2/ Figures followed by same letter are not significantly different at the 5% probability level according to Duncan's Multiple Range Test.

Table 4. Response of FC 31702 and Lincoln grafts to potassium. 1972.

Graft[1/]	Pods/Plant				Seed/Pod				Grams/100 seed			
	K0	K1	K3	Mean	K0	K1	K3	Mean	K0	K1	K3	Mean
FC/FC	159.9d[2/]	265.2a	255.4a	226.83a	2.0cd	2.1bc	2.1bc	2.07b	15.7abc	17.2a	16.2abc	16.37a
FC/L	199.3bcd	226.0abc	233.6ab	219.63a	1.9d	2.1bc	2.1bc	2.03b	15.3bce	15.7abc	15.7abc	15.57ab
L/FC	168.2d	171.2d	174.4cd	171.27b	2.1bc	2.4a	2.4a	2.30a	15.0cd	15.9abc	16.4abc	15.77ab
L/L	173.7cd	168.1d	188.8bcd	176.87b	2.1bc	2.2b	2.5a	2.27a	14.3d	14.9cd	16.8ab	15.33b
Mean	175.28b	207.62a	213.05a		2.02b	2.20a	2.28a		15.08a	15.92a	16.28a	

1/ FC/FC, FC/L, L/FC, and L/L symbols stand for scion over root grafts of FC 31702/FC 31702, FC 31702/Lincoln, Lincoln/FC 31702, and Lincoln/Lincoln, respectively.

2/ Figures followed by same letter are not significantly different at the 5% probability level according to Duncan's Multiple Range Test.

Maryland Soybean Variety Tests

J. A. Schillinger, R. Hutchison, D. Brower, and K. Nicodemus
Department of Agronomy

Purpose and Objectives

The number of new soybean varieties available to Maryland farmers continues to increase. Variety trials are necessary to evaluate new and established soybean varieties for Maryland's climate, soils, and diverse cropping systems. Conditions of these trials must be maintained at 'farm-like' settings so that the results can be directly applied to Maryland farms.

Procedures

Nine locations were selected to conduct the 1972 variety trials; seven were planted as a full season crop and two locations were planted after barley. A randomized complete block design was used at each location with three replications. Each entry was planted in a three-row plot, 20 feet long. Row widths used were the same as those used by the cooperating farmer. Twenty-one entries were compared in the Eastern Shore locations and sixteen entries were tested on the Western Shore.

Results

Yields for the soybean entries evaluated on the Eastern Shore, both in a full season and double-cropping planting, are presented in Table 1. Also included in Table 1 is the two-year average for most of the entries. The recommended varieties - Essex, Cutler, Columbus, Williams, Kent, Calland, and Wye - for the Eastern Shore occupied the top seven positions in average yields over 1971 and 1972 in the full season planting.

The list of top yielding varieties changed in the double-cropping plantings. The earlier maturing varieties planted after barley apparently

were favored by rainfall distribution and generally outyielded the later varieties. An early frost (October 20) also limited the yields of the late varieties. Williams, Wye, Columbus, and Calland produced the best yields for both 1972 alone and the two-year average of 1971-72.

In Piedmont Maryland tests, the top-yielding varieties were Calland, Williams, Wye, Cutler 71, and Cutler (Table 2). This was true for both 1972 and the 1971-72 averages. The late maturing entries such as York, V-156, and Essex are definitely out of their area of adaptation. Their yields were significantly less than those of the top five varieties listed above.

On August 1, 1972, Essex, a new soybean variety from Virginia, was released for Maryland soybean growers . Essex has been evaluated since 1968 in Maryland under conditions similar to those described above. The yields and overall desirability of Essex have been outstanding. Its maturity - five days earlier than York - should make it ideal for Maryland's Eastern Shore and southern Maryland. Table 3 contains the cumulative data of Essex for 1971 and 1972.

Summary

The recommended soybean varieties for Maryland have continued to set the pace in the 1972 Soybean Variety Trials. Essex was named and released in 1972 and should become one of the most popular varieties in Maryland.

Table 1. Average yields (Bu/A) of soybean varieties on the Eastern Shore when planted as full season crop (5 locations[1/]) and after barley (Hurlock - Preston) - 1971-72.

Full Season			After Barley		
	Yield (Bu/A)			Yield (Bu/A)	
Variety	1971-72	1972	Variety	1971-72	1972
Essex	43.1	40.5	Williams	42.8	40.6
Cutler	41.4	40.2	Wye	42.3	42.9
Columbus	41.0	36.2	Columbus	42.2	44.3
Williams	40.5	36.7	Calland	41.5	43.1
Kent	40.4	37.9	Cutler	41.5	39.5
Calland	39.4	41.1	Kent	41.3	38.6
Wye	38.2	36.2	Cutler 71	39.7	39.2
Cutler 71	37.3	39.9	Essex	38.7	37.0
SRF-400	37.0	34.6	York	38.3	36.9
Delmar	36.8	32.3	Delmar	37.5	39.4
York	36.8	36.8	Wayne	36.2	37.3
Md 410	36.0	33.7	SRF-400	35.9	40.0
Bonus	35.6	37.7	Dare	35.0	34.5
Dare	35.4	33.7	Mack	34.0	32.2
Wayne	35.2	40.1	Bonus	-	44.5
Mack	34.5	34.0	Md 1258	-	40.9
Md 1258	34.2	36.0	SRF-450	-	40.2
SRF-450	-	38.1	Md 410	-	36.8
V-156	-	34.5	V-156	-	32.5
Coker 70-136	-	32.8	Coker 70-136	-	30.7
FFR 666	-	24.0	FFR 666	-	19.9
Mean		36.0			37.7
LSD (.05)		6.2			5.2
CV (%)		9.8			8.0

1/ Kennedyville, Wye Institute, Poplar Hill, Linkwood, Princess Anne.

Table 2. Average yield (Bu/A) of soybean varieties grown as full season crop in the Piedmont area of Maryland.

Variety	Yield (Bu/A)	
	1971 & 1972	1972
Calland	41.4	39.4
Williams	40.9	38.7
Wye	39.8	39.0
Cutler 71	39.5	37.5
Cutler	38.0	36.1
Wayne	37.6	36.3
SRF-307	37.5	36.9
SRF-400	36.8	33.5
Kent	36.3	36.6
SRF-450	35.7	35.8
Bonus	35.1	32.6
Columbus	34.2	34.6
Delmar	-	32.3
Essex	-	32.1
York	-	29.5
V-156	-	25.0
Mean		34.7
LSD (.05)		5.5
C.V. (%)		7.2

Table 3. Average performance of Essex, York, Dare, and Hill soybean varieties in 1971-72.

Variety	Yield (Bu/A)	Maturity Date	Height (in)	Lodging Score 1/	Seed Quality Score 1/	Seed per Pound	Chemical Content	
							Oil (%)	Protein (%)
Essex	47.3	10-12	32	1.7	1.9	3100	21.8	40.6
York	43.8	10-17	36	1.9	1.9	2500	21.8	39.5
Dare	40.6	10-15	38	2.4	2.0	3100	23.4	39.0
Hill	38.4	10-08	36	2.4	2.0	3200	23.5	37.7

1/ Lodging scored from 1, erect to 5, prostrate.
Seed quality scored from 1, excellent to 5, very poor.

No-Tillage Studies in Double-Cropped Soybeans

J. A. Schillinger, L. H. Smith, and F. R. Mulford
Department of Agronomy

Purpose and Objectives

Double-cropping of small grain and soybeans has increased in popularity among Maryland farmers. The greatest deterrents to high soybean production in this cropping system are delay in planting date and lack of adequate moisture. The no-tillage method of planting shows promise in reducing the risk involved with both of these factors.

The objectives of this study were (1) to study the effects of row width on soybean production and (2) to compare no-tillage and conventional methods of planting.

Procedures

Five planting treatments were used for the Wye and York soybean varieties. The treatments included:

1. Conventionally prepared soil - 20" row width
2. Conventionally prepared soil - 30" row width
3. No-tillage planting - 15" row width
4. No-tillage planting - 20" row width
5. No-tillage planting - 30" row width

Three replications of each treatment were planted in a barley stubble using randomized complete block design. The study was planted at Poplar Hill Research Farm on June 16 and at Wye Institute Farm on June 18.

The plot area was treated with paraquat at 1 qt/acre, Lasso at 2 qt/acre, and Lorox at .75 lbs AI/acre. Good weed control was obtained from this herbicidal treatment.

Results

Soybean yields in narrow rows (15" and 20") from the no-tillage planting were significantly higher than in the 30" row width at both locations.

Soybeans grown in the 15" row width under no-tillage at Poplar Hill yielded 52.8 bushels per acre as compared to 40.5 bushels per acre for the 30" no-tillage treatment. This yield advantage was found in the York and Wye varieties at Poplar Hill and in the York variety at the Wye Institute. At the Wye Institute, a significant difference was also found between row widths in the conventional planting with the narrow row treatment being superior.

The average yields of Wye and York were very close at both locations. However, the yields at Poplar Hill were decidedly higher than at the Wye Institute: 46.4 vs. 32.0 bushels per acre. A droughty period in late August and early September adversely affected yields at the Wye Institute.

Summary

Narrow row widths are essential for increasing yields in double-cropped soybeans. The no-tillage method of planting, using narrow row widths, produced similar or higher yields than conventionally planted soybeans.

Table 1. Yield (bushels/acre) of Wye and York soybean varieties when planted in 5 different planting methods at Poplar Hill Research Farm and Wye Institute Farm.

Planting Treatment	Row Width (in)	Yield (Bu/A) Poplar Hill Wye	Poplar Hill York	Poplar Hill Treatment Means	Wye Institute Wye	Wye Institute York	Wye Institute Treatment Means
Conventional	20	42.6	48.1	45.4 b[1/]	34.3	35.3	34.8 a
	30	45.5	44.2	44.9 b	27.7	30.5	29.1 b
No-Tillage	15	53.2	52.4	52.8 a	33.5	33.2	33.4 a
	20	50.1	47.4	48.8 ab	32.9	33.2	33.1 a
	30	40.6	40.3	40.5 c	33.2	26.0	29.6 b
Variety Means:		46.4 a[2/]	46.5 a		32.3 a	31.6 a	

1/ Treatment means followed by a different letter are significantly different at 5% level of probability.

2/ Variety means followed by same letter indicate no significant difference.

Yield Reduction in Soybeans due to Mexican Bean Beetle Feeding

J. A. Schillinger and T. Eldon
Agronomy Department and USDA Entomology Division

Purpose and Objectives

The Mexican bean beetle (Mbb), Epilachna varivestis, has become the leading insect pest of soybeans in Maryland. Recent progress in soybean breeding at Maryland has resulted in the development of an advanced breeding line, V69-156, which has resistance to the Mbb. These studies were conducted to meet the following objectives:

(1) To determine the amount of yield loss inflicted to the standard variety, York, and the resistant line, V69-156.

(2) To determine the amount of yield loss in four commercially grown soybean varieties of different maturity.

Procedures

A. York and V69-156

A split-plot design was used for this study; the whole plot treatment was the insecticide, Sevin, and the subplot treatments were soybean varieties, York and V69-156. The plots were established at the Poplar Hill Research Farm on May 25. Uniform stands of both varieties were maintained through harvest. One insecticide application of Sevin at 1 lb of A.I./Acre was applied on August 28 to the treated sub-plots. Mexican bean beetle populations never attained critical levels in this study; however, those present in the plots were controlled by Sevin.

B. Yield Loss among Five Soybean Cultivars

This experiment also utilized a split plot design with insecticide

treatments again being the whole plots and soybean cultivars the subplots. Four replications of each treatment were established on June 10. The cultivars planted included York, Essex, Mack, Columbus, and V69-156. Mexican bean beetle populations were monitored throughout the growing season. Sevin was applied on September 8 at the rate of 1 lb A.I./Acre.

Results

The data in Table 1 reflect the differential soybean cultivars to Mbb feeding. York, a susceptible variety, showed only slight yield loss, whereas Mack appeared to be very susceptible even to low Mbb infestations. York's yield loss of 1.4 and 2.0 bushels/acre is the lowest we have found in four years of testing.

The ability of the resistant line, V69-156, to avoid yield loss was again evident. In both studies, its yields were slightly better in the non-treated plots as compared to the plots treated with insecticide.

The amount of foliar damage inflicted by the Mexican bean beetle to the five cultivars of soybeans is given in Table 2. As can be seen from this data, V-156 suffered significantly less injury in both dates of scoring. V-156 was the only cultivar to not suffer increased feeding damage between the September 14 and October 3 dates of scoring.

Summary

Resistance to the Mexican bean beetle, as found in V-156, appears to be effective in preventing economic yield loss to beetle feeding. V-156 had significantly less feeding injury and did not suffer any loss of yield in these tests.

Table 1. Yield loss in soybean cultivars due to Mexican bean beetle feeding. Poplar Hill Research Farm - 1972.

Cultivar	Yield (Bu/Acre) No Insecticide (NI)	Insecticide (I)	Difference (NI-I) 1/
Study A:			
York	37.3	38.7	-1.4^{NS}
V69-156	38.5	38.1	$+0.4^{NS}$
Study B:			
York	41.7	43.7	-2.0^{NS}
V69-156	39.9	39.4	$+0.5^{NS}$
Mack	28.3	38.7	-10.4^{**}
Essex	40.5	40.9	-0.4^{NS}
Columbus	40.1	41.5	-1.4^{NS}

1/ NS - no significant difference between control (I) and no control (NI) treatments.

** - indicates significant difference at 1% level of probability.

Table 2. Mexican bean beetle damage scores[1/] of five soybean cultivars. Poplar Hill Research Farm - 1972.

Cultivar	9-14-72	10-3-72
York	5.3	6.8
V-156	3.6	3.5
Mack	4.8	5.5
Essex	4.4	6.0
Columbus	5.1	8.3
LSD_{05}	0.6	1.4

1/ Rated on 1-10 basis with 1 being no damage and 10 being 100% defoliation

Effect of Fall and Spring Plowing on Soil Aggregate Stability and Corn Yield Under Various Cropping Systems

E. Strickling
Department of Agronomy

Purpose and Objectives

To determine the effect of fall and spring plowing for corn and soybeans on soil moisture, soil aggregate stability, and crop yield under various cropping systems.

Procedure

One-half of each corn plot in a cropping system experiment on Beltsville silt loam was plowed each fall and the remaining half was plowed in April. This experiment includes long and short rotations as well as continuous corn with a rye-vetch cover crop. Soil samples were taken for soil moisture and soil aggregation determination.

Results

The corn and soybean yields are presented in Tables 1 and 2, sweet corn yields in Table 3, and wheat yields in Table 4. Yields previous to 1967 are presented for purpose of comparison although all plots were spring plowed during this period. Soil aggregation and soil organic matter content data are shown in Tables 5 and 6.

Summary

Fall plowing has had little effect on crop yield although fall plowing has been better in some years. This may be due to plowing when the soil is too wet in the spring which would depress the yields of spring-plowed plots. The 170 lbs. of nitrogen had about the same effect as 100 lbs. of nitrogen on all crops in most years but response was obtained to the extra nitrogen in 1971 and 1972. Cropping systems have had large effects on crop yields and soil organic matter content. Aggregation was not effected by fall plowing.

Table 1. Field Corn Yields in Cropping System Experiment.

Cropping System**	Time of Plowing	1970		1971		1972		Ave. 1967-72		Ave.* 1959-66		Ave.* 1952-58
		100 N bu./A	170 N bu./A	100 N bu./A	170 N bu./A	100 N bu./A	170 N bu./A	100 N bu./A	170 N bu./A	100 N bu./A	170 N bu./A	100 N bu./A
Cont. C	Spring	87.8	87.5	100.3	124.7	57.8	68.3	87.1	93.7	53.6	61.9	72.6
	Fall	72.8	78.2	104.9	124.2	63.8	83.9	88.6	98.6	51.4	54.4	73.3
C□ W	Spring	82.7	106.3	78.9	88.2	70.3	87.4	92.3	98.2	54.8	54.2	69.5
	Fall	94.6	98.0	89.6	117.2	75.5	73.5	93.3	97.4	51.9	51.9	75.6
CW	Spring	88.2	87.8	121.3	126.0	76.2	74.6	102.4	101.3	62.4	63.0	71.9
	Fall	97.3	89.1	137.0	137.0	95.8	74.2	109.6	105.9	64.0	61.2	70.8
CSW	Spring	91.6	108.2	104.3	127.0	101.2	104.5	107.2	112.8	62.7	62.1	73.4
	Fall	92.5	98.3	123.3	141.3	107.9	102.2	112.4	112.7	62.1	61.5	76.2
CWH	Spring	120.9	98.5	145.7	159.7	85.3	122.0	111.8	120.8	64.7	62.2	70.0
	Fall	113.6	96.8	147.3	176.3	103.2	120.2	117.8	126.1	66.9	65.5	76.1
CWHH	Spring	119.2	91.5	130.3	138.0	125.8	141.6	122.8	122.8	66.6	67.9	73.2
	Fall	135.0	93.9	151.7	163.0	125.1	113.8	132.8	124.9	66.5	69.2	79.6
CWPPP	Spring	111.2	142.6	154.7	156.0	102.5	112.0	117.5	131.2	69.6	71.4	72.6
	Fall	108.1	114.3	160.7	151.7	116.2	120.9	124.9	126.6	72.0	70.3	76.0
Ave.	Spring	100.2	103.2	119.4	131.4	88.4	101.5	106.0	111.6	61.1	63.2	71.9
	Fall	102.0	95.5	130.7	144.4	98.2	98.4	111.4	113.1	62.1	62.0	75.4
	Ave.	101.1	99.4	125.0	137.9	93.3	99.9	108.6	112.4	61.6	62.6	73.6

* All plots were plowed about May 1 previous to 1967. A soil conditioner was applied in 1952 on all plots that were fall plowed starting with 1967.

** C = corn, C□ = corn with stalks left on, W = wheat, H = alfalfa hay, P = ladino clover - orchard grass.

Table 2. Soybean Yields in Cropping System Experiment.

Cropping* System	Time of Plowing	Year 1967 bu./A	1968** bu./A	1969 bu./A	1970 bu./A	1971 bu./A	1972 bu./A	1967-72 (Av.) bu./A	1952-66 (Av.)*** bu./A
Cont. soybeans (W, cover)	Spring	56.2	19.8	36.8	34.8	41.1	27.4	36.0	22.1
	Fall	53.8	20.2	24.7	38.4	40.6	31.8	34.9	23.2
C,S,W rotation	Spring	53.1	27.6	41.2	42.6	50.0	33.0	41.3	27.0
	Fall	47.5	31.7	37.1	39.3	51.1	33.5	39.0	27.1
Av.	Spring	54.6	23.7	39.0	38.7	45.5	30.2	38.6	24.5
	Fall	50.6	26.0	30.0	38.9	45.8	32.7	37.3	25.2
	Av.	52.6	24.8	34.9	38.8	45.7	31.4	38.0	24.8

* C = corn, S = soybeans, W = winter wheat.
** Fall plowing was delayed to February by weather.
*** All plots were spring plowed from 1952 to 1966.

Table 3. Sweet Corn Yields in Cropping System Experiment.

Time of Plowing	1960 100 ton/A	1960 170 ton/A	1971 100 ton/A	1971 170 ton/A	1972 100 ton/A	1972 170 ton/A	Av. 1967-72 100 ton/A	Av. 1967-72 170 ton/A	Av.* 1959-66 100 ton/A	Av.* 1959-66 170 ton/A	Av.* 1952-58 100 ton/A
Spring	3.33	3.58	3.05	2.74	2.02	2.84	3.10	3.27	2.22	2.06	2.73
Fall	3.46	4.17	3.78	3.64	2.27	3.24	3.18	3.65	2.24	2.17	2.93
Av.	3.40	3.88	3.42	3.19	2.14	3.04	3.14	3.46	2.23	2.12	2.83

* All plots were spring plowed previous to 1967. A soil conditioner was applied in 1952 on the plots that were fall plowed in 1967 to 1970.

Table 4. Wheat Yield in Cropping System Experiment.

Cropping**** System	Land* Prep.	1968 100 N	1969 100 N	1970** 100 N	1971	1972	Av. 1968-72	Av.*** 1953-67
		bu./A	bu./A	bu./A	bu./A	bu./A	bu./A	
Cont. W	No plow	11.2	29.2	13.5	16.9	27.4	19.6	31.7
	No plow	9.9	28.8	13.8	19.4	26.2	19.6	31.2
C□W (stalks left)	Spring	10.0	24.2	34.4	60.6	48.2	35.5	33.1
	Fall	10.7	22.2	40.4	54.2	50.1	35.5	33.1
CW (stalks removed)	Spring	18.2	22.4	40.6	50.9	45.3	35.5	34.8
	Fall	18.0	20.5	40.9	57.0	41.2	35.5	34.3
SwC W	Spring	30.4	29.5	47.9	67.9	53.9	45.9	36.2
	Fall	25.4	28.2	43.9	68.1	55.4	44.2	36.6
CSW	Spring	21.7	32.9	50.1	67.0	49.6	44.3	37.6
	Fall	21.8	31.7	48.9	77.1	49.8	45.8	39.3
CWH	Spring	14.6	20.1	37.5	61.8	50.1	36.8	36.9
	Fall	19.2	22.2	43.4	64.3	51.6	40.1	36.9
CWHH	Spring	31.8	18.9	38.9	56.4	40.6	37.3	35.2
	Fall	28.1	19.5	37.6	68.7	39.3	38.6	36.4
CWPPP	Spring	17.4	25.5	39.0	58.9	44.8	37.1	35.1
	Fall	23.5	27.0	40.7	62.8	42.9	39.4	36.4
Av.	Spring	20.6	24.8	41.2	60.5	47.5	38.9	35.1
	Fall	20.9	24.5	42.3	64.6	47.2	39.9	35.2
	Av.	20.8	24.6	41.8	62.6	47.4	39.4	35.3

* Land was prepared for wheat by discing plots that had been spring and fall plowed for corn.

** Blueboy wheat used in and after 1970. Seneca used in previous years.

*** All plots were spring plowed for corn during this period.

**** C□ = corn with stalks left, C = corn with stalks removed, SWC = sweet corn, W = wheat, H = alfalfa hay, P = ladino clover - orchard grass mix.

Table 5. Soil Aggregation of Fall and Spring Plowed Plots in a Cropping System Experiment on Beltsville Silt Loam.

Cropping System*	Aggregation			
	Aug. 3, 1972		Average 1967-1972	
	Fall Plowed %	Spring Plowed %	Fall Plowed %	Spring Plowed %
Cont. Corn* (stalks left Rye vetch cover)	13.3	11.6	13.3	14.8
Corn*, Wheat (stalks left)	23.2	22.2	22.0	22.4
Corn*, Wheat (stalks removed)	22.9	20.3	16.7	18.9
Sw. Corn*, Wheat	15.7	16.3	17.2	17.3
Corn*, Wheat, Hay	16.1	18.0	18.5	20.0
Corn*, Soybeans, Wheat	23.4	19.3	17.9	19.1
Corn*, Wheat, Hay, Hay	21.2	24.6	23.2	24.8
Corn*, Wheat, 3 years Orchard Grass & Ladino Clover	24.7	34.1	33.2	34.7
Cont. Soybeans*	8.2	9.3	8.8	8.8
Soybeans*, Wheat Corn	14.3	14.2	13.9	15.4
Cont. Fallow*	6.4	6.2	6.2	6.1
Average	17.2	17.8	17.4	18.4

* Sample plots.

Table 6. Soil Organic Matter Content of Plots in Cropping System Experiment on Beltsville Silt Loam.

Cropping System**	Av. Soil Organic Matter 1952 %	1972 %
Cont. Corn (stalks left, Rye Vetch Cover)	1.56	1.58
Corn*, Wheat (stalks left)	1.59	1.66
Corn*, Wheat (stalks removed)	1.57	1.52
Sweet Corn*, Wheat	1.60	1.56
Corn*, Wheat, Hay	1.55	1.50
Corn*, Soybeans*, Wheat	1.63	1.58
Corn*, Wheat, Hay, Hay	1.77	1.97
Corn*, Wheat, 3 years Orchard Grass & Ladino Clover Mix	1.65	1.86
Cont. Soybeans	1.69	1.29
Cont. Bluegrass	1.63	2.24
Cont. Orchard Grass	1.62	2.10
Cont. Bare Fallow	1.56	.71

* Sampled plots

** Cropping systems were established in 1952 on land that had been in a corn, wheat, and hay rotation for 15 years so the soil organic matter was close to the equilibrium content for the corn, wheat, and hay rotation.

Interactions Among Soybean (*Glycine max*) Cultivars, *Rhizobium* Strains, and Fertilizer Nitrogen Levels

V. L. Miller
Plant Nutrition Laboratory, Plant Physiology Institute, USDA
D. F. Weber
Plant Nutrition Laboratory, Plant Physiology Institute, USDA
and Department of Agronomy

Purpose and Objectives

Soybeans are generally grown without the addition of nitrogen fertilizer. Most growers depend on the natural fertility of the soil, or carryover nitrogen from the preceding crop, to nourish the young seedlings until symbiotic fixation can furnish the required nitrogen. *Rhizobium japonicum* bacteria are responsible for the formation of the nodules that fix the nitrogen. However, not all *Rhizobium* strains are good nitrogen fixers on a given plant variety.

The purpose of this experiment was to evaluate the interactions among selected soybean varieties, *Rhizobium* strains, and fertilizer nitrogen levels; and to determine the feasibility of adding fertilizer N should the host-strain combination prove incompatible, or ineffective in reaching adequate N-production levels for good plant nutrition.

Procedure

This experiment was conducted at the University of Maryland Tobacco Experimental Farm on *Rhizobium*-free soil. The field was divided in half, and 100 lb per acre of nitrogen, applied as ammonium nitrate, was added to one half and the other half left untreated (whole plots). Three soybean varieties were inoculated with each of 16 strains of *R. japonicum* and randomly planted in soil containing each N level. Each variety subplot contained an uninoculated row to measure the effect on yield from soil N. Subplots and sub-sub-plots (*R. japonicum* strains) were replicated three times.

Results

The mean yield data for each soybean variety and R. japonicum strain are presented in Table 1. Analysis of variance indicated that whole-plot and subplot effects were highly significant. The addition of N increased mean yields from 27.6 to 35.3 bu/A. Highly significant differences attributable to R. J. strains were noted. Highest yields were obtained from the inoculated plots. Varieties yielded highest when inoculated with strain 122. A non-nodulating variety A62-8 yielded 14.6 and 29.9 bu/A without and with added N, respectively.

The first-order interactions, soybean variety X nitrogen rate, variety X strains, and nitrogen rate X strains, were highly significant. A given variety, when inoculated with certain strains, performed better with applied N.

The second-order interaction among Rhizobium strains, nitrogen levels, and soybean varieties was significant at the 5% level.

Summary

Soybean variety X Rhizobium strain X nitrogen level interaction indicates that plants inoculated with the best N-fixing strains showed no significant yield increase with applied nitrogen, whereas nitrogen applied to plants with inefficient or only moderately efficient strains increased the yield.

Table 1. Soybean varieties X *Rhizobium* strains X nitrogen rates.

Mean yield in bushels per acre for 3 replications

	Variety					
	Kent		Scott		Wye	
	Nitrogen rates					
	0	100 lb	0	100 lb	0	100 lb
Strains						
A62-8	13.7	33.4	15.4	27.9	14.9	28.6
Uninoculated	24.3	32.5	23.1	34.1	26.9	36.9
6	32.1	38.6	29.4	31.4	31.4	35.7
31	21.6	37.3	26.6	36.8	25.6	33.5
38	27.9	40.2	38.0	37.9	23.8	38.5
59	28.1	37.8	32.3	34.6	33.9	40.6
62	31.4	36.9	28.6	38.5	24.5	38.4
71a	25.0	36.3	31.4	38.7	28.6	36.0
76	26.8	40.7	32.2	34.6	26.4	29.7
100	27.9	36.4	27.8	33.8	30.3	31.4
110	24.1	32.6	35.9	38.7	33.5	38.8
117	32.4	39.5	34.5	29.1	26.0	36.2
122	34.5	37.8	35.7	37.6	31.3	33.1
123	26.4	37.7	30.6	27.4	24.0	37.2
126	21.0	36.9	23.2	30.2	19.3	34.3
135	20.4	32.1	19.4	31.5	17.9	33.6
138	29.8	38.3	30.3	38.0	32.2	34.4
140	32.0	34.4	37.7	33.9	28.8	34.3

Rhizobium Strain Evaluation for Soybean Yield on *Rhizobium*-free Soil

D. F. Weber
Plant Nutrition Laboratory, Plant Physiology Institute, USDA
and Department of Agronomy

V. L. Miller
Plant Nutrition Laboratory, Plant Physiology Institute, USDA

Purpose and Objectives

Testing strains of *Rhizobium* obtained worldwide for the Beltsville *Rhizobium* Culture Collection is a primary objective. New isolates are routinely sought from domestic and international sources. Isolates showing promise in greenhouse testing are further tested under field conditions. The objective of this investigation was to evaluate selected isolates in soil not planted previously to soybeans.

Procedure

The experiment was conducted at the University of Maryland Tobacco Experimental Farm on Donlonton fine sandy loam that had assayed *Rhizobium*-free. Single-row plots of Kent soybeans, spaced 36" and replicated four times per isolate, were planted after inoculating the seed in packets. Planting was done by hand to avoid cross-contamination of plots. Soybean yield was determined from 16 ft of row.

Results

Seed yields and agronomic characteristics of Kent soybeans inoculated with the individual isolates are shown in Table 1. Seed-yield differences are an indirect measure of the relative efficiency of the individual isolates to fix nitrogen symbiotically. All isolates evaluated, except 126 and R54A, showed significant yield increases over that of the control at the 0.01 level of significance.

Summary

Soybean yield was significantly increased over the control by 6 of the 8 isolates tested. The 12.3 bu/A yield increase of the most efficient host-isolate combination agrees very closely with strain evaluations conducted over several years at the Tobacco Experimental Farm and parallels inoculation responses reported nationally when soybeans are planted in *Rhizobium*-free fields.

Table 1. Evaluation of Rhizobium japonicum strains on Kent soybeans in Rhizobium-free soil. Tobacco Research Farm, University of Maryland, 1972.

Inoculant strains	Yield (bu/A)	Yield (rank)	Plant Traits: Maturity (date)	Plant Traits: Lodging (score)	Plant Traits: Height (inches)	Quality (score)	Size (g/100)
110	38.9	1	43	1.0	28	3	19.3
6	35.7	2	42	1.0	28	3	18.9
140	35.2	3	42	1.0	29	3	19.2
138	34.9	4	42	1.0	28	3	19.0
141	34.4	5	42	1.0	28	3	18.9
122	33.6	6	42	1.0	26	3	19.3
R54A	30.0	7	41	1.0	26	3	18.7
126	26.8	8	40	1.0	25	3	18.3
Check	26.6	9	41	1.0	26	3	18.8
L.S.D. (0.05)	4.58						
(0.01)	6.20						
C.V. (%)	14.3						